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THE JOHNS HOPKINS UNIVERSITY

Editor—HENRY E. SIGERIST

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Editor—HENRY E. SIGERIST

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THE DEVELOPMENT OF GREEK ANATOMY[1]

LUDWIG EDELSTEIN

The dissection of the human body is one of the great scientific contributions of the Greeks. As far as we can tell, no one had ever before ventured to perform an anatomy.[2] My purpose is to explain why, in Greece, such dissections could be exercised. But first, I have to show what the significance of dissection is, in its relation to medicine. On this the solution of the problem depends.

Modern physicians who consider the explanation and treatment of diseases impossible without an understanding of the structure of the human body, agree that dissection is the only means whereby the necessary knowledge may be acquired. And every medical student learns the facts as he himself dissects. However, we must not take for granted that the same attitude existed in antiquity.

In ancient medicine, too, there is an association between the knowledge of the structure of the human body and the treatment of diseases. In the 5th and 4th centuries B. C., when the so-called Hippocratic writings were assembled, it seems that certain humors circulating through the body are responsible for illnesses. And even

[1] This paper was read in a seminar course on the history of anatomy. As regards a detailed argumentation, I refer to "Die Geschichte der Sektion in der Antike," *Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin*, III (Berlin, 1932), pp. 100-156; see also note 22.

[2] Anatomy in the modern sense of the word means the knowledge of the structure of the human body. But the word itself, derived from the Greek ἀνατέμνειν, only means dissection, signifying a method of research rather than a degree of knowledge.

now a few authors consider it advantageous to know how the cavities of the body through which these humors flow are formed. One source says, " I hold that it is also necessary to know which diseased states arise from powers and which from structures. What I mean is, roughly, that a " power " is an intensity and strength of the humors, while " structures " are the conformations to be found in the human body." [3] And another book at least distinguishes between the diseases which " have their seat where they can be seen " and other diseases which have " a seat where they cannot be perceived." [4] The latter are " those which are determined to the bones or the cavities," and " their obscurity however does not mean that they are our masters, but as far as is possible they have been mastered, a possibility limited only by the capacity of the sick to be examined and of researchers to conduct research." [5] And another author even says, " The nature of the body is the beginning of medical study." [6] However, at this time such statements occur only sporadically.

But then, since the beginning of the 3rd century B. C., the dogmatic physicians who think it possible to explain diseases by theories, emphasize that in internal diseases the organs are the origin of illnesses, and that it is impossible to discover the organs without studying the human body. And " besides, as pains and various other disorders, attack the internal parts, they believe no person can apply proper remedies to those parts of which he is ignorant." [7] The empiricists who went no further than experience allows, agree with the dogmatists in that physicians should know the human structure, since experience teaches that the treatment of diseases depends upon the organs.[8] Only the last Greek medical school founded in the 1st century A. D., the methodic school, again repudiates the necessity of this knowledge in accordance with its refutation of

[3] π. ἀρχαίης ἰητρικῆς, Ch. XXII, Hippocrates, translated by W. H. S. Jones (Loeb Classical Library), I, p. 57.

[4] π. τέχνης, Ch. IX, Hippocrates, *loc. cit.*, II, p. 207.

[5] π. τέχνης, Ch. X; XI, Hippocrates, *loc. cit.*, II, pp. 207; 209.

[6] π. τόπων τῶν κατ' ἄνθρωπον, Ch. II, *Oeuvres complètes d'Hippocrate*, par E. Littré (Paris, 1839), VI, p. 278.

[7] *Celsus de medicina*, translated by James Greive (London, 1756), p. 7.

[8] Celsus, *loc. cit.*, pp. 11, 12.

every explanation, every statement concerning the connection between two facts. However, a few later methodists study the body because a knowledge of the organs indicates greater erudition, even if such a knowledge is not useful for medical practice.

From the 3rd century B. C., then, the Greek and Roman physicians in general hold a knowledge of the human body to be important. Before that time, at least a few physicians study the human body. But in spite of that, the dissection of human bodies is never the only method of study. In the 5th and 4th centuries B. C., the physicians dissect dead and living animals, and make their assertions by inference from the bodies of animals to those of men.[9] And the nature of the organs is determined by other analogies. Thus it is said, " Some (of the conformations which are found in the human body) are hollow, tapering from wide to narrow; some are expanded, some hard and round, some broad and suspended, some stretched, some long, some close in texture, some loose in texture and fleshy, some spongy and porous. Now which structure is best adapted to draw and attract to itself fluid from the rest of the body, the hollow and expanded, the hard and round, or the hollow and tapering? I take it that the best adapted is the broad hollow that tapers. One should learn this thoroughly from unenclosed objects that can be seen. For example, if you open the mouth wide you will draw in no fluid; but if you protrude and contract it, compressing the lips, and then insert a tube, you can easily draw up any liquid you wish. Again, cupping instruments, which are broad and tapering, are so constructed on purpose to draw and attract blood from the flesh. There are many other instruments of a similar nature. Of the parts within the human frame, the bladder, the head, and the womb are of this structure." [10] In this case the physicians make inferences from organs which can be seen and from familiar instruments to organs which cannot be observed. A knowledge of the internal organs is also acquired by experience: " Medicine, being prevented, in cases of empyema, and of diseased liver, kidneys, and the cavities generally, from seeing with the sight with which all men see everything most perfectly, has nevertheless dis-

[9] E. g., π. καρδίης, Ch. 2, Hippocrate, par E. Littré, *loc. cit.*, IX, p. 80.
[10] π. ἀρχαίης ἰητρικῆς, Ch. 22, Hippocrates, ed. Jones, *loc. cit.*, I, pp. 57-58.

covered other means to help it. There is clearness or roughness of the voice, rapidity or slowness of respiration, and for the customary discharges the ways through which they severally pass, some times smell, sometimes colour, sometimes thinness or thickness furnishing medicine with the means of inferring, what condition these symptoms indicate, what symptoms mean that a part is already affected, and what that a part may hereafter be affected. When this information is not afforded, and nature herself will yield nothing of her own accord, medicine has found means of compulsion, whereby nature is constrained, without being harmed, to give up her secrets." [11] These, in the beginning, are the analogical methods of learning.

The practice of anatomy as the dissection of the human body itself begins only in Alexandria in the early part of the 3rd century B. C., when the dogmatists realize the whole importance of this knowledge of the human body. They say, that " it is necessary to dissect dead bodies, and examine their viscera and intestines, and (therefore) that Herophilos and Erasistratos had taken by far the best method for attaining that knowledge, who procured criminals out of prison, by royal permission, and dissecting them alive, contemplated, while they were even breathing, the parts which nature had before concealed; considering their position, colour, figure, size, order, hardness, softness, smoothness and asperity, also the processes and depressions of each, or what is inserted into, or received by another part." [12] Dissection, both of living and of dead human beings, is practised by the dogmatists, the former seeming the most expedient practice.

But at once the opposition arises. Although the empiricists admit that a knowledge of the human body is necessary, they refute dissections, either of dead or living human bodies. It is not only useless but cruel, to cut open living men, especially " if it be considered, that some of those things which are sought after with so much barbarity, cannot be known at all, and others may be known without any cruelty . . . that the abdomen indeed may be opened, while a man breathes; but as soon as the knife has reached the praecordia

[11] π. τέχνης, Ch. XIII, Hippocrates, ed. Jones, *loc. cit.*, II, pp. 213-215.
[12] Celsus, *loc. cit.*, p. 7.

. . . the man immediately expires and thus the praecordia and all the viscera never come into the view of the butchering physician until the man is dead." [13] The empiricists say further, " If there be anything which can be observed in a person, that yet breathes, chance often throws it in the way of such as practise the healing art; for that sometimes a gladiator on the stage, a soldier in the field, or a traveller beset by robbers, is so wounded, that some internal part, different in different people, may be exposed to view; and thus a prudent physician finds their situation, position, order, figure, and the other particulars he wants to know, not perpetrating murder, but attempting to give health; and learns that by compassion, which others had discovered by horrid cruelty. That for these reasons it is not necessary to lacerate even dead bodies . . . the dressing of wounds shows all that can be discovered in the living." [14] The empiricists believe, then, that fortuitous knowledge is sufficient, and frankly call it an " anatomy by chance." [15]

The dogmatists alone continue to practise anatomy as the dissection of human bodies. They do so until the 1st century A. D. From that time on, human dissection becomes impossible even for them, though they still consider it essential. During the 2nd century A. D. Alexandria is the only place, now, in which such dissections can be performed: " Make it your earnest business, then, not only to learn exactly from the book the appearance of each of the bones, but to become yourself by the use of your own eyes an eager first-hand observer of human osteology. At Alexandria, this is very easy, since the physicians in that country accompany the instruction they give to their students with opportunities for personal inspection (autopsies). Hence you must try to get to Alexandria for this reason alone, if for no other." [16] But in general, it is now said, " Listen, then, and look at this slave, and you shall commit to memory first what is superficially visible. Next, I will try to teach you what the interior parts are to be called, by dissecting some

[13] Celsus, *loc. cit.*, pp. 11, 12.

[14] Celsus, *loc. cit.*, p. 12.

[15] Galen, ed. Kühn, XIX, p. 357, fr. 67, Deichgräber, *Die griechische Empirikerschule* (Berlin, 1930).

[16] Galen, *ἀνατομικαὶ ἐγχειρήσεις*, I, Ch. II, translated by A. J. Brock, *Greek Medicine* (London), p. 161.

animal which is most like a human being. For, even if they are not alike in every respect, still there is nothing to prevent one from demonstrating at least the essentials of every part. In the old days, these matters were demonstrated in a more noble fashion, on the human subject." [17]

The consequence of these facts, of course, is that anatomy is never the only method of acquiring the knowledge of the human body in ancient times. In the 5th and 4th centuries B. C., pupils learn by dissecting animals, or by other analogies and by experiences. The disciples of the dogmatic school alone then learn by dissecting human beings, either dead or living, as long as it is possible. Later, for them too, anatomy by chance and dissection of animals again replace the dissection of men: "If you cannot manage (to go to Alexandria and to learn on the human body itself), still it is not impossible to obtain a view of human bones. Personally I have very often had a chance to do this where tombs or monuments have become broken up. On one occasion a river, having risen to the level of a grave which had been carelessly constructed a few months previously, easily disintegrated this; then by the force of its current it swept right over the dead man's body, of which the flesh had already putrefied, while the bones were still closely attached to one another. This is carried away downstream for the distance of a league, till, coming to a lakelike stretch with sloping banks, it here deposited the corpse. And here the latter lay ready for inspection, just as though prepared by a doctor for his pupils' lesson. Once also I examined the skeleton of a robber, lying on a mountain-side a short distance from the road. This man had been killed by some traveller whom he had attacked, but who had been too quick for him. None of the inhabitants of the district would bury him; but in their detestation of him they were delighted when his body was eaten by birds of prey; the latter, in fact, devoured the flesh in two days and left the skeleton ready, as it were, for anyone who cared to enjoy an anatomical demonstration. As regards yourself, then, even if you do not have the luck to see anything like this, still you can dissect an ape, and learn each of the bones from it, by carefully re-

[17] Rufus, *π. ὀνομασίας τῶν τοῦ ἀνθρώπου μορίων*, introduction in Brock, *loc. cit.*, p. 126.

moving the flesh." [18] Thus the later dogmatists seek for knowledge. The pupils of the empiricists, as always, round out their studies by chance, by healing, and even by reading books.[19]

To sum up: although there is a connection between the knowledge of the human body and medicine, dissection of human bodies is not the only means of studying and acquiring sufficient knowledge. This method is discovered only in the beginning of the 3rd century B. C., and without having been generally recognized, it is exercised only till the 1st century A. D. And now the question comes up, why, at a certain time, dissection of human beings is developed, why it becomes at all a possibility and a necessity in Greece.

The Greeks, like all ancient people, have a fear of dead bodies. All acts of violence upon a body are held as odious. To care for the burial of every corpse is a duty; no obligation of one relative to another is of greater import. For the dead may not find rest in the realm of death until their bodies are given proper burial. They may take vengeance on the relatives who neglect their obligations to their dead. These magic beliefs always remain in force. The idea that the dead can punish the living for every slightest disrespect is prevalent throughout antiquity. Considering these theories, it seems impossible that the Greeks can ever have done any dissecting. But they do dissect. It is the scholars who have a spirit of inquiry and who perform the dissections. Their ideas can be quite unrelated to the opinions of the ordinary layman. The opposition to dissection, then, may have prevented the scholars from having easy access to cadavers, but it would have been possible to overcome such opposition at that time as it was in the Renaissance.

But in the 6th and 5th centuries B. C., the beliefs of scholars and laymen are still identical. Even philosophers of this period take for granted that after death the human body is capable of sensation.[20] It is significant of a great advancement of thought that no differentiation is made between burial in the earth of one's own native country and in that of a foreign country; as it is said, " The road

[18] Galen, *ἀνατομικαὶ ἐγχειρήσεις*, I, Ch. II, in Brock, *loc. cit.*, pp. 161-162.

[19] Galen, ed. Kühn, XIII, pp. 607-609, fr. 69-70, Deichgräber, *loc. cit.*

[20] Democritus, 55 A 117; 160-161; 109. Parmenides, 18 A 46, cf. B 13, in Hermann Diels, *Die Fragmente der Vorsokratiker* (Berlin, 1922), 4th ed.

to the lower world is as long from one place as from another." [21] The paradox of Heraclitus that the corpse has to be thrown out with even less hesitation than dung, is based on a religious belief of impurity rather than on a rational theory, and is, above all, an isolated one.[22]

But then in the 4th century B. C., the Platonic philosophy evolves a decisive general change of thought among the scholars. In one of the Platonic dialogues, Socrates says, after having discussed the immortality of souls, and having been asked by Crito how he wished to be buried, " However you please, if you can catch me and I do not get away from you." And he laughed gently, and looking toward us, said, " I cannot persuade Crito, my friends, that the Socrates who is now conversing and arranging the details of his argument is really I; he thinks I am the one whom he will presently see as a corpse, and he asked how to bury me. And though I have been saying at great length that after I drink the poison I shall no longer be with you, but shall go away to the joys of the blessed you know of, he seems to think that was idle talk, uttered to encourage you and myself. . . . I shall not remain when I die, but shall go away, so that Crito may bear it more easily, and may not be troubled when he sees my body being burnt or buried, or think I am undergoing terrible treatment, and may not say at the funeral that he is laying out Socrates, or following him to the grave, or burying him." [23] So the fear of death and of dead bodies is clearly overcome on a rational basis. Plato, who distinguishes between the world of ideas and the world of reality, between the soul of man and the body of man, recognizes the fact that " the soul is wholly superior to the body, and that in actual life what makes each of us to be what he is is nothing else than the soul, while the body is a semblance which attends on each of us, it being well said that the bodily corpses are images of the dead, but that which is the real self of each of us, and which we term the immortal soul, departs to the

[21] Anaxagoras, 46 A 34 a, in Diels, *loc. cit.*

[22] Heraklitus, 12 B 96; cf. B 98, in Diels, *loc. cit.* R. Harder reminded me of this fragment, which I did not consider in my first paper.

[23] Phaidon, 115 c-e, Plato, translated by H. N. Fowler (Loeb Classical Library), I, pp. 393-395.

presence of other gods." [24] Man and his body are never identical, either during life or after death. The conception of the true reality of the soul makes the body unreal and negligible.

Aristotle follows these Platonic theories. A new general attitude towards life and death is now created. The Hellenistic physicians, who first exercised dissections of human beings, the dogmatists, are disciples of these philosophers. They are scholars, and are closely connected with the philosophical thinking. They too, therefore, have no delusions as to the ability of the dead body to feel, to take vengeance, to punish those still alive. It is only a thing of flesh and bones. Besides, the whole Hellenistic philosophy holds the same views. What Epicurus says, " The wise man will not think about burial " [25] is valid with all of them. Physicians and philosophers of this period maintain the same belief that prompts Vesalius to adopt this motto for one of the figures in his *Fabrica Corporis Humani* as an expression of his attitude towards anatomy: Vivitur ingenio, caetera mortis erunt — it is his genius that yet walks the earth; all else of him may go down into silence.[26] They, therefore, are, like Vesalius, able to dissect human beings. Before that time, such a thing would have been impossible.

There remains, of course, a certain revulsion against such studies. The empiricists inveigh at some length against the cruelty of human dissection. It is not only cruel, it is " shocking to the sight " too, as they say.[27] And it is likely that the dogmatists have had the same feeling. But at the same time in which the fear of dead human bodies is conquered, the revulsion against shocking inquiries is, on the whole, overcome by the aim of intellectual perception: " We proceed to treat of animals, without omitting, to the best of our ability, any member of the kingdom, however ignoble. For if some have no graces to charm the sense, yet even these, by disclosing to intellectual perception the artistic spirit that designed them, give immense pleasure to all who can trace links of causation, and are inclined to philosophy. . . . We therefore must not recoil with childish aver-

[24] *Laws*, XII, 959 a-b, Plato, translated by Burry, *loc. cit.*, X, p. 533.
[25] Epicurus, fr. 578, in Usener, *Epicurea* (Leipzig, 1887).
[26] See Singer, *The Evolution of Anatomy* (London, 1925), VIII and fig. 103.
[27] Celsus, *loc. cit.*, p. 12.

sion from the examination of the humbler animals. Every realm of nature is marvelous: and as Heraclitus, when the strangers who came to visit him found him warming himself at the furnace in the kitchen and hesitated to go in, is reported to have bidden them not to be afraid to enter, as even in that kitchen divinities were present, so we should venture on the study of every kind of animal without distaste; for each and all will reveal to us something natural and something beautiful . . . if any person thinks the examination of the rest of the animal kingdom an unworthy task, he must hold in like disesteem the study of man. For no one can look at the primordia of the human frame — blood, flesh, bones, vessels and the like — without much repugnance." [28] The physicians have at least the same interest in the subject as the philosophers. They are motivated by a desire to understand and aid in the conquering of illness. They too have to overcome their repulsion for dissection.

The Greek and Roman physicians do dissect as long as these thoughts are alive. But from the 1st century B. C., human dissections cease to be performed. There is another change of thinking. The Romans, who are the dominating factor of that era, respect the dead, and are superstitious beyond all other people. The Roman law highly respects and assiduously protects the dead body. Philosophy itself becomes suffused with superstition. There is no longer an absolute freedom of inquiry. The few physicians who still want to dissect, are not able to do it. Only in Alexandria is teaching with a skeleton still possible during the 2nd century B. C. There, perhaps, the old dogmatic traditions are still stronger than anywhere else. Later, in every case, dissection becomes an impossibility throughout the whole Roman Empire. And physicians themselves renounce it. The attitude of scholars and laymen is again the same as it was before the development which led to dissection began.

Only the Greek physicians of a certain period can dissect. There remains a last question — why do they consider it imperative to dissect human beings? There are many other methods of acquiring the necessary information. Even at this time, when the dissection of human beings becomes an authorized procedure, a great many

[28] *π. ζώων μορίων*, I 5, 645 a 6-30. In *The Works of Aristotle*, edited by Smith and Ross, V (Oxford, 1912).

physicians feel that the old methods are sufficient. And above all, as far as we know, until the 3rd century B. C., no one has ever wanted to dissect human bodies. Everyone is satisfied with the studies based on animal dissection or on other analogies. Why does it suddenly seem so necessary for the physicians to make their inquiries directly on the subject of their interest? And why do they perform vivisections? That can be explained through the history of analogical thinking in antiquity.

In the 5th and 4th centuries B. C., the whole inquiry into nature is based upon the belief that there exists an all-embracing uniformity in nature. It is thought possible to explain anything by referring it to something else. For instance, one can explain the changes in the heavens according to human behavior, or the changes in the earth according to the growth of a plant. For heaven and man, earth and plant, are identical if one takes into consideration the last principles of genesis. A philosopher of this time, therefore, can say: "earth's sweat, the sea." [29] The same law is always valid. It is therefore possible to compare man and animals without going wrong. The inferences based upon analogies evolve a knowledge which is absolutely unchallengeable. And so the physicians need inquiries into the human body itself as little as do the philosophers. In these centuries, animal dissection and other analogies continue to be adequate.

But the faith in analogy is gradually done away with. Even in the 4th century B. C., Aristotle attacks the analogical statements. He considers them gross exaggerations: "It is equally absurd to suppose that anything has been explained by calling the sea 'the sweat of the earth,' like Empedocles. Metaphors are poetical and so that expression of his may satisfy the requirements of a poem, but as a scientific theory it is unsatisfactory." [30] Aristotle himself distinguishes between *analogous* and *similar:* "All animals have a part analogous to the chest in man, but not similar to his; for the

[29] Fr. 55, in *The Fragments of Empedocles*, translated by W. E. Leonard (Chicago, 1908).

[30] μετεωρολογικά, II 3, 357 a 24-28. In *The Works of Aristotle*, *loc. cit.*, III (Oxford, 1931).

chest of man is broad, but that of all other animals is narrow." [81] And he makes no inferences from the organs of animals to those of human beings, except in comparing their functions. Analogies become an uncertain basis for study. Comparisons between men and animals cannot justifiedly be unrestricted.

Theophrastus, a disciple of Aristotle, goes still further. In his book on botany he says, "It is waste of time to take great pains to make comparisons where that is impossible, and in so doing, we may lose sight also of our proper subject of inquiry." [82] The consequence is that great scientific discoveries go unrecognized because the scholars have no longer the courage to compare, for instance, plants and animals. The bisexual nature of plants is recognized, but Theophrastus is now afraid to formulate his observation as a law of nature.

Theophrastus is aware that the way of studying the internal parts of plants is similar to that of the study of animals by dissection.[83] The Alexandrian physicians, who are the first to dissect, study in the Aristotelian school. Theophrastus, who, above all other philosophers, is cautious in making analogical inferences, teaches Erasistratus, one of the first and greatest anatomists of antiquity. Like Theophrastus and contemporary philosophers, the physicians, I imagine, admit now that inferences by analogy are not sufficiently dependable. They are no longer satisfied with analogies between animals and men, and are therefore compelled to dissect human beings rather than animals, to study the subject of their inquiries itself. It is the same time in which the fear of human corpses is dispelled. Physicians now may dissect unreservedly.

But the dogmatists consider vivisections to be far more instructive than dissections of dead bodies. They declare, "It is by no means cruel, as most people represent it, by the tortures of a few guilty, to search after remedies for the whole innocent race of mankind in all ages." [84] Also it is not necessary to make frequent

[81] *π. ζώων ἱστορίας*, II 1, 497 b 36-38. In *The Works of Aristotle, loc. cit.*, IV (Oxford, 1910).

[82] *π. φυτῶν ἱστορίας*, I 1, 4, Theophrastus, translated by A. Hort (Loeb Classical Library), I, p. 7.

[83] Theophrastus, *loc. cit.*

[84] Celsus, *loc. cit.*, p. 8.

vivisections, though it is at times compulsory. And the empiricists think vivisections to be cruel and useless, only because it is impossible to reach the ultimate aim of such inquires. For they, too, believe, " that nothing can be more ridiculous, than to imagine anything to be the same in a dying man, nay one already dead, as it is in a living person. . . . Most things are different in dead bodies." [85] Why do the Greek physicians believe this? It is, of course, an observation of the fact that certain definite and obvious changes take place in a dead body, an observation which anyone is able to make. In spite of that, in the 5th and 4th centuries B. C., such observations, if they are made, are never seriously taken into consideration, or given anything like their real significance. Even dissections of dead and living animals have an equal value. The philosophers, who take for granted that the dead body is capable of sensation, also make no distinction between the visible aspects of dead and living bodies.

But then, in the 4th century B. C., Aristotle, in accordance with Plato, advances a new theory. He says, " Does, then, configuration and colour constitute the essence of the various animals and of their several parts? For if so, what Democritus says will be strictly correct — he says that it is evident to everyone what form it is that makes the man, seeing that he is recognizable by his shape and colour. And yet a dead body has exactly the configuration as a living one; but for all that it is not a man. So also no hand of bronze or wood or constituted in any but the appropriate way can possibly be a hand in more than name . . . precisely in the same way no part of a dead body, such I mean as its eye or its hand, is really an eye or a hand . . . it is plain, then, that the teaching of the old physiologists is inadequate, and that the true method is to state what the definitive characters are that distinguish the animal as a whole . . . this something that constitutes the form of the living being is the soul . . . when the soul departs, what is left is no longer a living animal, and none of the parts remain what they were before, excepting in mere configuration, like the animals that in the fable are turned to stone." [86] It is the new conception of the value of the soul which

[85] Celsus, *loc. cit.*, pp. 11, 12.

[86] *περὶ ζώων μορίων*, I 1, 640 b 30-641 a 22. In *The Works of Aristotle, loc. cit.*

destroys the fear of dead bodies. It is this same attitude which brings about vivisections, and makes them more valuable than dissection of dead bodies. Physicians now realize the importance of these differences, which they have observed before, between dead and living bodies. The dissection of cadavers can only teach the configuration and position of organs, while vivisection can teach the nature of the internal parts and the causes of life. They therefore want to dissect living beings. The advantages of such studies they believe are sufficient excuse for their cruelty.

To conclude: anatomy as the dissection of the human body is performed in Greece and Rome only from the 3rd century B. C. until the 1st century A. D. At this time the magic and religious fear of dead bodies is overcome by the philosophical thinking. Inferences by analogy are replaced by a more scientific method, by the study of the subject itself. At this moment, therefore, it becomes possible and necessary to dissect human beings, and the Greek physicians venture to undertake it.

CELSUS' "ON MEDICINE" AND THE ANCIENT MEDICAL SECTS

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Celsus' eight books on medicine are one of the best and most important medical works which antiquity has left us,[1] but they present a puzzle to the medical historian, as well as to the philologist. For they seem not to fit into the general development of classical medicine; they possess a disturbing originality which puts them outside the known sects. Furthermore, Celsus, as a layman, not a professional physician, appeared the least credible author for such independent views. Many and widely differing theories have been brought forward to explain these difficulties, but, in my opinion, the following two questions are still open for discussion: In what does the originality of Celsus' book consist? On what general medical tradition of his time is he dependent?

A. The Originality of Celsus' Work

1.

The answer to the first question must be sought in an analysis of the contents of his work in relation to its form and purpose.

Celsus' work "On Medicine" starts with an introduction in which he lays down his general views on the medical art. This prologue is followed by eight books relating the treatment of diseases by diet (including hygiene and semeiology), drugs and surgery.[2]

[1] For general information about Celsus I refer to the usual textbooks of medical history by Castiglioni, Diepgen, Garrison, Neuburger, Neuburger-Pagel (article by Bloch) and Sudhoff.

[2] Cf. Ilberg (1), p. 392. — Strictly speaking, the dietetic part of the work begins already with paragraph 12 of the introduction (ed. Marx, p. 19, 4-6: Quoniam autem ex medicinae partibus ut difficillima, sic etiam clarissima est ea, quae morbis medetur, ante omnia de hac dicendum est. — Cf. Wellmann (1), col. 1274-1275). The dietetic treatment represents the methodical cure of diseases (quae morbis medetur), whereas the treatment by drugs is either additional to the first (cf. II, 33, 1), or directed against various impairments which may befall the body (V, 1, 2; ed. Marx, p. 190, 11-13: Verum ut illud (i. e. preference of dietetic treatment) in plerisque morbis utilius est, sic multa admodum corporibus nostris incidere consuerunt, quae sine medicamentis ad sanitatem pervenire non possunt).

The work is a uniform whole.[3] Books 1-8 reflect the general ideas of the introduction and follow a definite methodical arrangement.

The introduction maintains that the inquiry into the hidden causes of disease is not of immediate concern to the medical art (Introduction 47 and 74)[4] and, accordingly, with very few exceptions, we find them neither mentioned nor discussed in the eight books. But the evident causes, such as fatigue, thirst, cold, etc., which may bring about the disease, must be taken into consideration, as must also the nature of the patient — whether his body is moist or dry, whether his nerves are strong or weak, etc. (Intr. 52-53 and 74). Accordingly, these things are mentioned in the eight books: Some fevers may arise from bubos, fatigue or heat (III, 5, 1);[5] in cases of headache one has to pay attention to the causes which excited the pain (IV, 2, 6).[6]

By observing such evident causes the physician may be able to find

Similarly, books 7-8 deal with the surgical treatment of impairments such as wounds, tumours, fractures, dislocations, etc., rather than that of diseases. This shows that the discussion of the principles of medicine, hygiene and semeiology are all parts of dietetic medicine and that, therefore, Celsus does not follow the Empiricists' scheme, as suggested by Wellmann (2), p. 10.

[3] Cf. Marx, p. lxxvi ff.

[4] Ed. Marx, p. 25, 4-5: Quamquam igitur multa sint ad ipsas artes proprie non pertinentia, tamen eas adiuvant, etc. — *Ibid.*, 29, 16-17: obscuris (i. e. causis) omnibus non ab cogitatione artificis sed ab ipsa arte reiectis.

[5] Ed. Marx, p. 108, 25-27: Igitur si semel tantum accessit, deinde desiit, eaque vel ex inguine vel ex lassitudine vel ex aestu aliave re simili fuit, etc.

[6] Ed. Marx, p. 152, 33-34: . . . dein considerandum est, quae causa dolorem excitarit.—Cf. also *ibid.*, p. 135, 1-4. Attention must be paid to the fact that books I and II (chapters 1-8) also give ample examples as to the rôle of evident causes in the preservation of health and the interpretation of prognostic signs. If, nevertheless, in the actual treatment of diseases, evident causes are not often mentioned (cf. Marx, p. xcv), this must be explained by the fact that the consideration of evident causes becomes important in single cases which do not fall under general rules and which, therefore, must be left to the conjectures of the physician. This idea of the impossibility of describing the "propria" is clearly stated by Galen, *Meth. med.*, III, chap. 3 (ed. Kuehn X, p. 181, 15 ff.; Deichgräber (1), pp. 151-152): *ἅπαντες γὰρ οἱ διορισμοὶ κατὰ πάσας τὰς τέχνας ἀπὸ τοῦ κοινοῦ πειρῶνται τὸ ἴδιον χωρίζειν · καὶ ὅτιφπερ ἂν τις πλεῖον διορίσηται, πλησιαίτερον ἀφικνεῖται τοῦ ἰδίου. τοῦτο δ'αὐτὸ τὸ ἀκριβῶς ἴδιον οὔτε γραφῆναι δυνατόν ἐστιν οὔτε λεχθῆναι. διὸ καὶ τῶν ἐμπειρικῶν τοῖς μάλιστα τῶν ἔργων τῆς τέχνης φροτίσασι καὶ σχεδὸν ἅπασι τοῖς δογματικοῖς ὠμολόγηται τὸ μηδεμίαν εἶναι οἷόν τ' εἶναι γραφῆναι θεραπείαν ἀκριβῶς, ἀλλὰ τὸ λεῖπον εἰς τὸν στοχασμὸν τῆς τοῦ κάμνοντος φύσεως οἱ μὲν ἐκ τῆς ἑκάστου τῶν θεραπευόντων οἰκείας τριβῆς, οἱ δ'ἐκ τοῦ λογικῶς τετεχνῶσθαι φασι χρῆναι προστιθέναι.*

new treatments for new diseases (Intr. 51-52);[7] reasoning is necessary in medicine (Intr. 48 and 74), for medicine is a conjectural art (Intr. 48).[8] This idea of the conjectural character of medicine is repeated in the semeiological part of the work (II, 6, 16) where the question is raised as to what certainty can be attributed to prognostic signs, since people given up by physicians have recovered. The answer is that medicine is a conjectural art and conjectures, while correct in most cases, can nevertheless sometimes deceive (II, 6, 13-16).[9] The same idea of the lack of absolute certainty in medicine (Intr. 48),[10] together with the value of experience (Intr. 47),[11] also explains the aversion towards too general rules.[12]

However doubtful the value of philosophical and scientific speculation may be, the physician must know the position and order of the parts of the body and the dissection of dead bodies is the necessary way by which to acquire such knowledge (Intr. 74).[13] Correspondingly, we find anatomical descriptions in books 1-8: book 4 starts with an anatomy of the organs which are the seat of internal diseases (IV, 1); an anatomy of the eye is contained in book 7 (VII, 7, 13), and book 8 starts with a description of the skeleton.

This recognition of anatomy is also noticeable in the arrangement

[7] Ed. Marx, p. 25, 26-30: Cum igitur talis res incidit, medicus aliquid oportet inveniat, quod non utique fortasse sed saepius tamen etiam respondeat. Petet autem novum quodque consilium non ab rebus latentibus (istae enim dubiae et incertae sunt), sed ab iis, quae explorari possunt, id est evidentibus causis.

[8] Ed. Marx, p. 25, 11-13: Ratione vero opus est ipsi medicinae, etsi non inter obscuras causas neque inter naturales actiones, tamen saepe . . .: est enim haec ars coniecturalis. — *Ibid.*, p. 29, 15-16: Igitur, ut ad propositum meum redeam, rationalem quidem puto medicinam esse debere, etc.

[9] Ed. Marx, p. 58, 22-25: Illa tamen moderatius subiciam, coniecturalem artem esse medicinam, rationemque coniecturae talem esse, ut, cum saepius aliquando responderit, interdum tamen fallat.

[10] Ed. Marx, p. 25, 13-15: Neque respondet ei plerumque non solum coniectura sed etiam experientia et interdum non febris, non †cibus, non somnus subsequitur sicut adsuevit. — Correspondingly he says in VII, 12, 4 (ed. Marx, p. 329, 16-18): Adeo in medicina, etiam ubi perpetuum est, quod fieri debet, non tamen perpetuum est id, quod sequi convenit.

[11] Ed. Marx, p. 25, 2-3: Verumque est ad ipsam curandi rationem nihil plus conferre quam experientiam.

[12] Cf. Marx' index, p. 470, s. v. "perpetua."

[13] Cf. ed. Marx, p. 29, 17-20: Incidere autem vivorum corpora et crudele et supervacuum est, mortuorum discentibus necessarium: nam positum et ordinem nosse debent, quae cadaver melius quam vivus et vulneratus homo repraesentat.

of the eight books, for as far as possible, Celsus begins with general points and things which apply to the whole body, proceeding afterwards to special points and diseases or treatments according to their anatomical substratum.[14] Thus, the general hygiene is followed by hygienic advice in cases where certain parts of the body are endangered; book 3 discusses diseases of the whole body, whereas diseases with a localized seat follow in book 4, arranged in anatomical order a capite ad calcem. A comparable division is found in the pharmaceutical books (V and VI) and in the surgical books too, where chapters 1-5 of book 7 discuss impairments which may befall any part, whereas chapters 6-33 again are devoted to a special discussion a capite ad calcem. The eighth book, dealing with fractures and dislocations, is arranged similarly.

The whole work, therefore, shows the deliberate plan of one author. However many sources he may have used, he has fully succeeded in combining them into one uniform whole.

2.

But books 1-8 also show a definite purpose which cannot directly be inferred from the introduction. The arrangement of the books under the three forms of treatment (by diet, drugs and surgery) reveals the practical point of view.[15] People are to be informed about the activities of the physician, so that they can either treat themselves or judge the physician's doings or find any practical information that may interest them.[15] This practical intention influences Celsus in his writing. In the introduction, he fully acknowledges the importance of anatomical knowledge. But in the following books anatomy is not treated in a special chapter; the anatomical

[14] Cf. Ilberg (1), p. 401.

[15] Cf. Jahn, p. 273; Ilberg (1), pp. 388, 394 and 402; Meyer-Steineg, pp. 28-29; Allbutt, p. 204. Allbutt also stresses the facts "that some knowledge of medicine was then customary among educated men in Rome, and domestic medicine practised by the head of the household on family, slaves, and cattle. Oribasius quotes Athenaeus as of opinion that no man of rank and responsibility could afford to be ignorant of medicine" (p. 204) and that Celsus' general hygienic advice is Roman in character (p. 209). According to Celsus, the healthy man may do what he likes (I, 1), whereas the Greek physicians, as Edelstein (1) has pointed out, even tried to regulate the life of the healthy. This contrast (cf. Edelstein, *ibid.*, pp. 261-262) could be explained by Celsus' Roman attitude.

descriptions are scattered over the work in connection with various subjects and, according to Celsus' own admission, he gives an outline only, just as much as is necessary for therapy (IV, 2, 1).[16]

This limitation imposed by the practical purpose of his work can also be seen in Celsus' attitude towards theoretical speculations. Although excluded from the art of healing itself, they are nevertheless considered in the introduction to be highly stimulating for the physician (Intr. 47).[17] Books 1-8 contain some examples which show that Celsus was interested in, or at least acquainted with, such theories: Discussing the various effects of rubbing, he explains how they can all be understood as effected by one cause, although, he adds, this consideration does not properly belong to the realm of the physician (II, 14, 3).[18] Similarly, in the chapters on "tabes," Celsus gives a short pathological theory of pulmonary tuberculosis: the disease starts from the head and goes over to the lungs which become ulcerated, and a slight fever results, etc. (III, 22, 3).[19] In yet another chapter, Celsus criticizes the view held by some people that the heat of the body is contained in the blood. In his opinion, it is not the nature of blood to be particularly hot; rather, of all things contained in the human body, blood is the quickest to heat and cool (IV, 6, 2).[20]

All this shows that books 1-8 do not reveal everything which, according to the author's opinion, might be worth knowing for a physician. Celsus' work is not a textbook on medicine; the practical

[16] Ed. Marx, p. 152, 1-2: His velut in conspectum quendam, quatenus scire curanti necessarium est, adductis, etc. — Cf. Castiglioni, p. 218.

[17] Ed. Marx, p. 25, 5-7: itaque ista quoque naturae rerum contemplatio, quamvis non faciat medicum, aptiorem tamen medicinae reddit perfectumque.

[18] Ed. Marx, p. 84, 6-8: Quas tamen species si quis curiosius aestimet (quod iam ad medicum non pertinet), facile intelleget omnes ex una causa pendere, quae demit.

[19] Ed. Marx, p. 135, 12-16: Tertia est longeque periculosissima species, quam Graeci pthisin nominarunt. Oritur fere a capite, inde in pulmonem destillat; huic exulceratio accedit; ex hac febricula levis fit, quae etiam cum quievit, tamen repetit; frequens tussis est, pus excreatur, interdum cruentum aliquid. — Cf. also IV, 15, 1 (ed. Marx, p. 169, 13: suppuratio in iocinere) and IV, 22, 1 (ed. Marx, p. 175, 28-29: intestina exulcerantur).

[20] Ed. Marx, p. 156, 19-23: Quod (i. e. blood-letting) quidam utique vitandum esse dixerunt, eo quod maxime tum corpus calore egeret, isque esset in sanguine. Verum hoc quidem falsum est: neque enim natura sanguinis est, ut utique caleat, sed ex is, quae in homine sunt, hic celerrime vel calescit vel refrigescit.

purpose eliminates everything which is not absolutely indispensable, although it may be valuable or even essential for a thorough study of medicine as such.

3.

It has been maintained that Celsus was not the author of this work, but that he merely translated the work of a contemporaneous Greek physician into Latin. Wellmann and Marx even went as far as to identify this real author. Wellmann first determined on Cassius,[21] but later changed his mind and substituted Menecrates,[22] while Marx pointed to Aufidius, a pupil of Asclepiades.[23]

The whole theory of a mere translation met with objections from philologists [24] as well as from medical historians [25] and the various contradicting attempts to find the original author are in themselves an argument against it. Cassius need not be discussed again, since Wellmann himself abandoned him.[26] In the case of Aufidius, the whole theory is based on three passages only, where Celsus expounds views similar to those of Aufidius. Wellmann has already shown that this basis is too small to prove anything and has further indicated the chronological difficulties which would arise from such a hypothesis.[27] Finally, as regards Menecrates, we know so little about him that it would be mere guesswork to identify him with Celsus.

Much importance has been attributed to the fact that Quintilian called Celsus a " mediocri vir ingenio," whereas the author of the work was certainly a man of keen mind and high intelligence.[28] But since Quintilian belonged to a later generation than Celsus, his characterization was scarcely founded on personal impressions. Rather, it must have been based on Celsus' literary work and if the sober and common-sense attitude which distinguishes Celsus' medical work also prevailed in his rhetorical writings, which have been lost,

[21] Cf. Wellmann (2), p. 122 ff.
[22] Cf. Wellmann (4), p. 212.
[23] Cf. Marx, p. lxxiv ff.
[24] Cf. Ilberg (2).
[25] Cf. Meyer-Steineg, p. 27 ff. and Allbutt, *loc. cit.*
[26] Cf. Wellmann (4), p. 212.
[27] Cf. Wellmann (3).
[28] Cf. Wellmann (2), p. 4; Marx, p. lxxv.

the remark of the rhetorician Quintilian would be quite understandable, though in no way binding.[20] On the other hand, Columella's favorable opinion of Celsus [30] is of much greater importance, since he lived nearer to Celsus' time and in, at least, one practical science, agriculture, had an interest in common with Celsus.

As far as I see, the only serious argument against Celsus' authorship is the contention that a layman seemed not to be the right person to pass such sound judgment on so many medical details, as does the author of the work, who writes in the first person. But as Ilberg rightly remarked, the boundary lines between the professional physician and the interested layman were by no means as sharply defined in antiquity as they are now.[31] Besides, it is not necessary to presume that all of Celsus' detailed opinions were of his own invention. Such books as he used may have contained doxographical material and in some cases he may have identified himself with ideas suggested to him. Thus for example, the agreements with Aufidius could be explained. Such procedure was not only common in antiquity, but would be understandable in a lay writer.

Finally, the strongest argument in favour of Celsus' authorship is his not being mentioned by later Greek physicians. This has been brought forward to prove that Celsus was a layman and can indeed be explained in that way. But, on the other hand, it would be very strange if the same work, written by a Greek physician, were passed over in silence.[32] If we substituted a Greek name for that of Celsus we should explain nothing, but should only increase the difficulties.

To sum up thus far, we can say that a single author, Celsus, wrote a practical book on medicine. In doing so, he made use of several medical books,[32a] making his own selections, adding popular treatments and allowing his attitude to be dictated by his own judgment. He formed these elements into one whole, reflecting certain general views on medicine, but eliminating everything which did not imme-

[20] Cf. Ilberg (2), p. 694.

[30] Ed. Marx, p. 1: . . . "Cornelium Celsum, non solum agricolationis, sed universae naturae prudentem virum . . ."

[31] Cf. Ilberg (1), p. 378; cf. also footnote 15.

[32] Cf. Meyer-Steineg, p. 27, footnote 2.

[32a] Cf. Ilberg (2), p. 695.

diately serve the practical purpose. To this extent, the work must be considered Celsus' original creation.

B. Celsus and Tradition

1.

The question of Celsus' dependence on tradition is nevertheless outstanding and can only be clarified by an examination of his historical position.

With the earlier Roman "encyclopedist," Cato, he shares the practical outlook which lends to his work a specifically Roman aspect.[33] His medical heritage proper, on the other hand, must be sought among the previous Greek schools of medicine. Here, it is not possible to distinguish clearly and in detail between Celsus' own contributions and those of his predecessors. This is not only true of the contents of books 1-8, but it also refers to the exposition of general views on medicine as laid down in the introduction. It would, therefore, be futile to ask whose medical ideas Celsus relates. For in philosophy, as Quintilian said,[33a] Celsus was a follower of the Sextians, an eclectic school which flourished in Rome at his time, and the whole introduction to his work, especially his attitude towards the sects, is eclectic in character. Thus, we can only ask to which line of Greek medical tradition Celsus belonged and to which physician he stood nearest.

An indication as to the answer to this question is given by the investigations of Wellmann, which have shown that the writings of Hippocrates, Heracleides of Tarent, Meges and Asclepiades and his school were the chief sources of the work.[34] For the present purpose, the name of Heracleides is of comparatively little importance since his writings, especially those of pharmacological character,[35] were used by physicians of various schools. As regards Hippocrates, he was claimed by both the Dogmatists and the Empiricists

[33] Cf. Jahn, p. 273 ff., Schanz, pp. 424-425, and Marx, p. vi ff. — For Celsus' connection with Varro, cf. Probst.

[33a] Cf. ed. Marx, p. 2.

[34] Cf. Wellmann (2) and (3).

[35] Cf. Wellmann (2), p. 39: "der Tarentiner galt auf diesem Gebiete als Autoritaet."

and it is, therefore, impossible to draw any immediate inferences from the fact that Celsus used him and estimated him highly. This then leaves only Asclepiades, Themison and the Methodists, for Meges, probably a pupil of Themison,[36] also falls into this line. Starting from these results, we have now to investigate how far they are corroborated by the introduction to Celsus' work.

2.

According to Celsus, the Dogmatists insist on four points: knowledge of the hidden causes of disease, knowledge of the evident causes of disease, such as heat, cold, hunger, etc. (Intr. 18), knowledge of the physiological functions and of the interior parts (Intr. 13).[37] The Empiricists, he says, admit the evident causes but they consider inquiry into the hidden causes and into the physiological functions superfluous, since nature is incomprehensible (Intr. 27).[38] They also refute vivisection and even dissections of dead human bodies as futile, cruel and disgusting; the physician can derive his knowledge from casual observations of wounded men (Intr. 40-44).

Celsus himself is neither Dogmatist nor Empiricist (Intr. 45).[39] Together with both sides, he accepts the evident causes (Intr. 52 and 74).[40] The dissection of dead bodies is necessary for the student, whereas vivisection is both cruel and superfluous (Intr. 74).[41] The Empiricists refer everything to experience and reject inquiries into the hidden causes; Celsus admits that nothing else contributes

[36] Cf. Raeder.

[37] Ed. Marx, p. 19, 11-14: Igitur ii, qui Rationalem medicinam profitentur, haec necessaria esse proponunt: abditarum et morbos continentium causarum notitiam, deinde evidentium; post haec etiam naturalium actionum, novissime partium interiorum.

[38] Ed. Marx, p. 22, 1-4: Contra ii, qui se Enpiricos ab experientia nominant, evidentes quidem causas ut necessarias amplectuntur: obscurarum vero causarum et naturalium actionum quaestionem ideo supervacuam esse contendunt, quoniam non conprehensibilis natura sit.

[39] Ed. Marx, p. 24, 25-28: . . . subiciendum est, quae proxima vero videri possint. Ea neque addicta alterutri opinioni sunt, neque ab utraque nimium abhorrentia, sed media quodammodo inter diversas sententias. Cf. Wellmann (4), p. 212.

[40] Cf. footnotes 7 and 8.

[41] Cf. footnote 13.

as much to medicine as experience (Intr. 47),[42] but even experience is not absolutely trustworthy (Intr. 48).[43] And whereas he too eliminates research into the hidden causes from the art of medicine, he thinks it of great stimulating value for the physician (Intr. 47 and 74)[44] and sometimes reveals his own interest in such theories.[45] For he does not say, as do the Empiricists, that nature is incomprehensible; he only points out that scientific views are reached by conjecture (Intr. 46) and that opinions as to the causes of disease do not lead to certainty in the finding of remedies (Intr. 46).[46]

Medicine, according to Celsus, is an "ars coniecturalis." This definition has a negative meaning in so far as it denies the possibility of absolute certainty in theoretical opinions, as well as in prognostic and therapeutical expectations. But it also has the positive meaning that reasoning cannot be omitted from medicine (Intr. 74)[47] and that the physician in each case has to take the individual factors into consideration and by conjecture find out new treatments (Intr. 51-52).[48] This definition, therefore, cannot be interpreted on empirical lines and besides, its formulation does not hail from the Empiricists. For Erasistratus already called therapeutics and semeiology "conjectural" parts of medicine[49] and the Pseudo-Galenic "Introductio" which is a later dogmatic outline of medicine, classi-

[42] Cf. footnote 11.
[43] Cf. footnote 10.
[44] Cf. footnotes 17 and 4.
[45] Cf. above.

[46] Ed. Marx, p. 24, 30-25, 2: Nam quae demum causae vel secundam valetudinem praestent, vel morbos excitent, quo modo spiritus aut cibus vel trahatur vel digeratur, ne sapientiae quidem professores scientia conprehendunt, sed coniectura persecuntur. Cuius autem rei non est certa notitia, eius opinio certum reperire remedium non potest.

[47] Ed. Marx, p. 29, 15-16: . . . rationalem quidem puto medicinam esse debere.

[48] Here Celsus opposes the Empiricists who based the treatment of new diseases on their similarity to well known ones. For he says (ed. Marx, p. 25, 23-26): Ad quod medicinae genus neque semper similitudo aliquid confert, et si quando confert, tamen id ipsum rationale est, inter similia genera et morborum et remediorum cogitare, quo potissimum medicamento sit utendum. This means that the τοῦ ὁμοίου μετάβασις of the Empiricists (cf. Deichgräber (1), pp. 301-305) is not always sufficient for the finding of new treatments and that it is itself actually a rational principle.

[49] Pseudo-Galen, *Introductio sive medicus*, chap. 5 (ed. Kuehn, XIV, p. 684): Τινὲς τῶν λογικῶν, ὧν ἐστι καὶ Ἐρασίστρατος, ὑπέλαβον τὸ μέν τι ἐπιστημονικὸν ἔχειν τὴν ἰατρικὴν, οἷον τὸ αἰτιολογικὸν καὶ φυσιολογικὸν, τὸ δὲ στοχαστικὸν, οἷον τὸ θεραπευτικὸν, καὶ τὸ σημειωτικόν.

fies medicine under the conjectural arts, too.[50] Although the author of this writing does not exclude scientific research from medicine,[51] he nevertheless contends in an argument parallel to that of Celsus that it does not insure any measure of absolute certainty.[52]

Celsus' position between the Dogmatists and Empiricists makes it impossible to consider him a strict follower of the Dogmatist, Asclepiades (Intr. 16), whose atomistic views he does not accept. He follows him to some extent in his dietetic books [53] and perhaps Celsus' admission of the necessity of dissecting dead bodies is, as Edelstein has pointed out,[54] dependent on Asclepiades, for the latter admittedly followed Democritus who deducted the nature of man

[50] *Ibid.*, p. 685, 14–686, 1: αἱ δὲ (i. e. τέχναι) ἐφίενται μὲν τοῦ ἑαυτῶν τέλους, ὡς σκοποῦ, οὐκ ἀεὶ δὲ αὐτοῦ τυγχάνουσιν, ἀλλ' ὡς ἐπὶ τὸ πολύ, διὸ καὶ στοχαστικαὶ λέγονται. τούτων ἂν εἴη καὶ ἰατρική, ὡς ῥητορικὴ καὶ κυβερνητικὴ καὶ τοξική.

[51] *Ibid.*, chap. 7, p. 689, 3-6: Μέρη ἰατρικῆς τὰ μὲν πρῶτά ἐστι, τό τε φυσιολογικὸν καὶ τὸ αἰτιολογικόν etc. and chap. 8, p. 690: Τὸ μὲν οὖν φυσιολογεῖν ἀναγκαῖόν ἐστιν etc. This proves the dogmatic character of the writing.

[52] *Ibid.*, chap. 5, p. 684, 17–685, 3: ἐπιστήμη γάρ ἐστι γνῶσις ἀραρυῖα καὶ βεβαία καὶ ἀμετάπτωτος ὑπὸ λόγου. αὕτη δὲ οὐδὲ παρὰ τοῖς φιλοσόφοις ἐστί, μάλιστα ἐν τῷ φυσιολογεῖν · πολὺ δὲ δὴ μᾶλλον οὐκ ἂν εἴη ἐν ἰατρικῇ, ἀλλ' οὐδ' ὅλως εἰς ἀνθρώπους ἔρχεται. διὸ τέχνη εἰκότως ἂν λέγοιτο ἡ ἰατρική.

[53] The importance of Asclepiades for Celsus has been recognized by both philologists and medical historians. Marx, p. lxxviii, has given an interesting list from which one may infer that for Celsus the "antiqui" are the physicians before Asclepiades, whereas the latter is the first "recentior" physician. Celsus' statement III, 4, 6 (ed. Marx, p. 105, 24-26): Plerique ex antiquis tarde dabant (i. e. food), saepe quinto die, saepe sexto; et id fortasse vel in Asia vel in Aegypto caeli ratio patitur. Asclepiades ubi . . . would also suggest that some of the physicians in Egypt (Herophilus, Erasistratus?) were considered "ancients" by him. Since he calls Hippocrates "vetustissimus auctor" (ed. Marx, p. 260, 4) the general term "antiqui" must have comprised some of his successors too, e. g. Diocles (ed. Marx, p. 309, 21-22: . . . Dioclen . . . quem inter priscos maximosque medicos fuisse iam posui). This is of some importance for the question whether, in the semeiological part, Celsus compiled his material from Hippocrates directly or not. Now Celsus himself says (II, 1; ed. Marx, p. 45, 1-4): In quibus explicandis (i. e. signis) non dubitabo auctoritate antiquorum virorum uti, maximeque Hippocratis, cum recentiores medici, quamvis quaedam in curationibus mutarint, tamen haec illos optime praesagisse fateantur. This would explain the many deviations from Hippocrates (cf. Wellmann (2), p. 11 ff.) since Hippocrates is the most important but not the sole ancient source for Celsus.

[54] Edelstein, personal communication. I am much indebted to Dr. Edelstein for valuable advice in the preparation of this study. It was his article on the "Methodiker" which first gave me the suggestion of a closer relation between Celsus and Themison.

from his morphological structure only.[55] Since, however, it is equally impossible to see in Celsus an adherent of the Empiricists, we have rather a man who, coming from the Dogmatic school, still believing in the rationality of medicine, revises his ideas and rejects speculative and scientific investigation. Thus far he would well agree with Themison who, as a pupil of Asclepiades, must at first have been a Dogmatist.

3.

In the short historical outline at the beginning of his introduction, Celsus names the men who did most for the advance of medicine (Intr. 11).[56] This list ends with Themison and for Celsus then, Themison is the last great physician.

The close relation between Celsus and Themison as regards the dietetic treatment of diseases has not been unnoticed,[57] but there was always one strong objection to any connection between them, for Themison was considered the founder of the Methodist school which is attacked by Celsus. Only recently has Edelstein shown that this was not the case.[58]

Themison was one of the successors of Asclepiades, but in old age, he changed the views of his master in certain respects (Intr. 11).[59] This cannot mean a change in some details only, for in the context of this passage Celsus wishes to point out the men who brought new views into medicine. The Methodists who grew out from the followers of Themison (Themisonis aemuli) considered him the author of their fundamental theories: especially the elimination of any causal thinking from therapeutics and the establishment of the three conditions of disease (communia) were attributed to him.[60]

[55] Cf. Edelstein (2), p. 93.

[56] Ed. Marx, p. 18, 30-19, 3: . . . donec Asclepiades medendi rationem ex magna parte mutavit. Ex cuius successoribus Themison nuper ipse quoque quaedam in senectute deflexit. Et per hos quidem maxime viros salutaris ista nobis professio increvit.

[57] Meyer-Steineg, p. 29: "Was nun die medizinischen Lehren des Celsus betrifft, so weisen sie mit denen Themisons mancherlei Wesensverwandtschaft auf."

[58] Cf. for the following, Edelstein (3) and Deichgräber (2). Deichgräber (*ibid.*, col. 1632) follows Edelstein at least in so far as to call Themison "Vorbereiter der methodischen Lehre" whereas formerly Themison had been thought its founder.

[59] Cf. footnote 56.

[60] Celsus, Intr. 54 (ed. Marx, p. 26, 12-14): et quidam medici saeculi nostri sub auctore, ut ipsi videri volunt, Themisone contendunt nullius causae notitiam quic-

They recognized two stages in his development, his adherence to Asclepiades and the later stage when, in many respects, his views corresponded to their own.[61]

Celsus, for his part, clearly distinguishes between Themison and the Methodists. He emphasizes that Themison's authorship is claimed by the Methodists, but he himself does not make Themison responsible for their teachings. Whereas Themison is for him the last great physician who influenced medical thinking, the Methodists have no right to consider themselves a new sect, for they are either Dogmatists or merely bad Empiricists (Intr. 62 ff.).[62] Celsus' attack on the Methodists implies, therefore, in no way criticism of Themison.

We do not know exactly what rôle the "communia" played in Themison's system. They may have been the central part, or he may only have mentioned them incidentally. However this may be, he must at least have recognized them.[63] So also does Celsus who, far from denying their existence (Intr. 73),[64] even applies them in his discussion of fevers (III, 6, 13-17).[65] And the other conception of the Methodists, their division of diseases into three stages (increscere — consistere — minui — cf. Intr. 55) is also accepted and applied by Celsus (III, 2, 2).[66]

quam ad curationes pertinere; satisque esse quaedam communia morborum intueri. — For further references, cf. Edelstein (3).

[61] For references, cf. Edelstein (3), col. 359 ff.

[62] Ed. Marx, p. 27, 17-30: Themisonis vero aemuli, si perpetua quae promittunt habent, magis etiam quam ulli rationales sunt. . . . Si, vero quod propius est, vix ulla perpetua praecepta medicinalis ars recipit, idem sunt quod ii, quos experimenta sola sustinent. . . . neque adiectum quicquam empericorum professioni, sed demptum est, quoniam illi multa circumspiciunt, hi tantum facillima, et non plus quam vulgaria.

[63] Cf. Galen, *Meth. med.*, I, chap. 4 (ed. Kuehn, X, p. 35, 6-10): *φαινομένας γοῦν εἰκὼν εἶναι τὰς κοινότητας ὁ σοφώτατος Θεσσαλὸς, ὀλίγον ὕστερον οὐ μόνον οὐδένα τῶν ἔμπροσθεν ἰατρῶν ἰδεῖν αὐτάς φησιν, ἀλλ' οὐδὲ τὸν πρῶτον γεννήσαντα Θεμίσωνα · τούτῳ γὰρ οὖν δὴ μόνῳ παραχωρεῖ καθάπερ πατρὶ τέκνα γνήσια τὰς τερατώδεις ἐκείνας κοινότητας.* Cf. Edelstein (3), col. 370.

[64] Ed. Marx, p. 29, 10-13: Ob quae conicio eum, qui propria non novit, communia tantum debere intueri; eumque, qui nosse proprietates potest, non illas quidem oportere neglegere, sed his quoque insistere.

[65] Cf. also VI, 6, 17 (ed. Marx, p. 268, 13-16): Quod si iam fastidium est eorum, quae pituitam crassiorem reddunt (sicut in hoc genere materiae maxime promptum est), confugiendum est ad ea, quae, quia ventrem, corpus quoque adstringunt.

[66] Ed. Marx, p. 102, 13 ff.: Videndum etiam est, morbus an increscat, an consistat, an minuatur, etc.

This is as far as we can go to prove that Celsus, in his whole attitude towards medicine, holds the same historical position as Themison, who left the strict Asclepiadean system and formed the link between Asclepiades and the Methodists.[67] Such a conclusion would explain both his rejection of the Methodist sect in the introduction and his detailed agreement in books 2-4 with the Asclepiadean tradition down to and including the Methodists.[68]

But it would be wrong to see in Celsus a mere Themisonean.[69] However near he may have stood to Themison, his attitude was at least critical and sometimes even polemical,[70] a fact which again demonstrates the intrinsic originality of his work.

[67] The sources are not quite clear as to Themison's later relation to the Methodists [cf. Edelstein (3) and Deichgräber (2)]. One possibility is that after having left the Asclepiadean sect he held opinions which could be interpreted by the Methodists as the basic principles of their own school. On the other hand, it is also possible that at the end of his life he actually took over some ideas from the Methodists. However this may have been, he must have held a rather uncertain position between the schools, inclining to various opinions so that Caelius Aurelianus could say about him (*Morb. chron.* I, 5, 179): *Themison . . .* qui se sua lege tenere non potuit (cf. Edelstein (3), col. 360). This comes rather near to the position of Celsus, who borrows from all sides without binding himself to any of them.

[68] Meyer-Steineg, p. 29, says: "Weit stärker aber noch als bei Themison und seinen unmittelbaren Schülern treten die grundsätzlichen Übereinstimmungen mit Celsus bei späteren Anhängern der methodischen Schule hervor. Ja, es ist beinahe, als ob diese gradezu im Sinne und auf Anregung des Celsus sich weiter entwickelt hätten." The latter phrase would exactly formulate the idea that Celsus represents the historical position of Themison.

[69] It would certainly be wrong to suppose that Celsus was a mere translator of Themison. As far as our knowledge goes, no writing of Themison's would correspond to the "On medicine" (cf. Deichgräber (2), col. 1637-1638). He seems chiefly to have written on chronic and acute diseases, a classification which Celsus did not consider exhaustive (III, 1, 1-3).

[70] Celsus criticises Themison in two instances (III, 3, 6-7 and III, 3, 17). Both instances concern the question when food has to be given to patients suffering from fever. In the first case, Themison had given a rather strict rule: (ed. Marx, p. 105, 27-31): At Themison nuper, non quando coepisset febris, sed quando desisset, aut certe levata esset, considerabat; et ab illo tempore expectato die tertio, si non accesserit febris, statim; si accesserat, ubi ea vel desierat, vel si adsidue inhaerebat, certe si se inclinaverat, cibum dabat. — Celsus refutes this rule as well as that of Asclepiades (*ibid.*) on the general principle (ed. Marx, 105, 31-32): Nihil autem horum utique perpetuum est. — The second case is somewhat similar in character. Since both instances, however, only concern a matter of detail, it is not possible to draw from them any general conclusions as to Celsus' relation to Themison.

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RELIGIOUS MOTIVES IN THE MEDICAL BIOLOGY OF THE XVIITH CENTURY *

WALTER PAGEL

V

The foregoing chapters have dealt with the individual trends of thought resulting from the conception of a uniform world on which the doctrines of Paracelsus were based, and have examined the negatively sceptical criticism expressed by Hirnhaim, who took as his model Agrippa of Nettesheym. It has been shown how, in the utterances of the alchemists and in the textbook of the Rosicrucians, religious scepticism with regard to existing rational and dogmatic science stimulated experimental work in medical biology. Chemistry, in particular, owes much to these tendencies, even if, for the time being, it must be satisfied with a close connection with religion, mysticism and magic. Finally, the example of Marcus Marci, in his embryology deduced from a speculative view of optics, has shown how conceptions relating to the metaphysics of light contributed to the mechanistic explanation of biological processes. In all these movements there has been one common element, the interdependence existing between the new scientific mode of thought and religion, each of which, at this time and particularly in the case of Paracelsus, was a source of inspiration to the other. The new conception of nature closely associated piety and experience, and both were regarded as immediately subordinate to the Divine Creator. It was in this sense that Comenius [1] recommended an approach to God and truth rather than to Aristotle and the opinions of the schoolmen in order to obtain a reliable philosophy: "Deo duce, ratione luce, sensu teste." It seems almost paradoxical that this religious contemplation played a part in the investigation of nature "iuxta propria principia" [1a] which is the

* See *Bulletin of the Institute of the History of Medicine*, vol. III, 1935, no. 2, pp. 97-128; no. 3, pp. 213-231.

[1] *Phys. synops., loc. cit.*, p. 34 ff.

[1a] According to *Telesius'* main book ("De rerum natura iuxta propria principia"). Lynn Thorndike, *A History of Magic and Experimental Science during the First 13 Centuries of Our Era* (London, 1923), Vol. 2, 535, refers to Bernhard von Gordon: "Scire unumquodque secundum quod in propria natura se habet, hoc enim

basis of the aspiration for new realities. The emphasis of the spiritual as the active force and of all transitions from spirit to matter in a monistic conception of the world, finally led to the creation of the new notion of disease. Even disease must be regarded as a new reality, a real thing, caused by a "species" from outside (contagium) and not only the expression of the relation between things, as in the case of antiquity, when disease was explained as the result of an abnormal mixture of the humours. Here begins the "system" of diseases, the ontological and etiological notion, allowing their classification.

A conception of unity, the conception of a uniform world, which regarded all things as united as if by a magic chain, was applied even to the off-shoots and details of scientific and experimental research, where its stimulating influence is apparent. The picture of unity is more clearly defined in the writings of Paracelsus than in those of his followers, where it is partly concealed by the quantity of the recently acquired empirical material. Once again the XVIIth century shows us in the writings of Robert Fludd an attempt to describe the world as a mystical unity. His work is an irregular mixture of theological parables, directly applied to the explanation of natural processes, of cosmic metaphysics, on which are based chemical and physical hypotheses, and finally, of purely mechanistic descriptions of physiological and pathological processes modelled on the study of physics.

Although there are certain judicious statements betraying considerable medical experience, as well as a description of a cleverly contrived instrument, something between a thermometer and barometer, the preponderance of the imaginary explanations and an overdone conception of uniformity in the world make it evident that the

optimum et perfectum est genus sciendi," because God reveals his will in nature (*Lil. med.*, V, 12). Forty years ago Jul. Leop. Pagel, in the introduction of his "edit. princ." of the *Areolae of Johannes de St. Amand* (Berlin, Reimer, 1893, p. xi), pointed out Gordonius' attitude of independence, especially in his treatise on the "Theriac," and later on his opposition to an uncritical imitation of authorities (Pagel, J. L., *Die Concordanciae des Johannes de Sancto Amando*, Berlin, 1894, p. xi). Bernhard of Gordon, in his treatise on "Theriac," quotes the doctrine of Averroës, previously mentioned on the "Proprietas" (syn. with "Tota species," "Forma substantiae," "Virtus orbis." Ed. princ. by J. L. Pagel, *Pharmaceutische Post*, Wien, XXVII, 205, 1894, p. 259).

value of Fludd's work to the progress of science is to be estimated as slight and in no way to be compared with that of Helmont.

While the works of Fludd are unproductive of discoveries, they form a profitable study insofar as they reveal the stimulus given by the contemporary view of the world to research in medical biology. Indeed, it is probable that the religious basis of experimental research has nowhere found such lucid expression as here. The examination of Fludd's biology is also instructive on account of the remarkable similarity of his ideas to those of the biology of the so-called romantic period which reflects an important current of thought at the beginning of the XIXth century.

The study of Fludd appears to be an excellent starting point for the discussion of the question as to whether romantic medicine represents a body of opinions of independent growth, with its own methods, investigations and solution of problems, or whether it is merely the attempt of a fanciful generation to resolve the ancient problem of the unity of the world, spirit and matter by the employment of the method approved since the age of Neoplatonism or even more ancient times, that of unlimited speculation.[2]

The lifetime of Fludd[3] (1574 to 1637) almost coincides with that of Harvey, Bacon, Rubens, Kepler, and van Helmont. Like the last, he is called "per ignem philosophus" and like him, too, he belonged to a family of some importance, his father being Sir Thomas Fludd, Paymaster to the Forces in France and the Netherlands during the reign of Queen Elizabeth. Fludd studied in Oxford (St. John's), after which he travelled extensively on the continent, where he became acquainted with the works of Paracelsus. In this again he may be compared with van Helmont, whom disgust with his scholastic education and a thirst for new realities drove forth into the world, to follow Paracelsus. About 1604, Fludd returned to England, took his medical degree at Oxford in 1605,

[2] See Diepgen, P., "Alte und neue Romantik in der Medizin," *Klinische Wochenschrift*, 1932, p. 28, and "Virchow und die Romantik" (review of Pagel's "Virchow und die Grundlagen der Medizin des XX. Jahrhunderts"), *Dtsche. mediz. Wochschr.*, 1932, pp. 1256/58.

[3] See on Fludd: Craven, F. B., *Rob. Fludd, the English Rosicrucian*, 1902. Further, A. E. Waite, *Rosicrucians, loc. cit.*, S. 274. See further, Gassendi, *Epistolica dissertatio in qua praecipua principia philosophiae R. Fluddi deteguntur*, 1631. — Marin Mersenne, *Correspondance*, ed. P. Tannery, I, 1617-27 (Paris, 1932).

was admitted as Fellow of the Royal College of Physicians in 1609, and set up a practice in London. In 1616 appeared his first defence of the Rosicrucians, and a year later the theological and philosophical pamphlet on "Life and Death and Resurrection," under the pseudonym of Rudolf Ocreb. The end of the second decade of the XVIIth century witnessed the publication of his more important writings, polemics against Kepler, Mersennus and Gassendi. His collected works appeared in six volumes at Oppenheim in 1638. The church of Bearsted in Kent contains his monument.

Although in education and early life he has much in common with Helmont, unlike the latter, in his more mature work he appears to be interested not so much in laboratory experiments as in the practice of medicine. A study of his writings with the view of obtaining some idea of this practice, leads to the conclusion that it was essentially astrological, uromantical and theosophical. In accordance with his fundamental opinion, prognostication from the constellations of the stars plays a conspicuous part. Actually it is this astrology which leads to the incorporation of the old humoralistic doctrines in his system of medicine, which is but the construction of a biology and pathology out of the comparison of macrocosm and microcosm, a comparison which he industriously works out in great detail.

All this clearly distinguishes him from Helmont, whose life work was so important in the evolution of natural science. But Fludd, from his own tenets has elaborated *one* particular part of the work of Paracelsus, and that alone should ensure for him the interest of the historian. Moreover, he is a fertile source of information on the contemporary conception of the world, and the ideas current and possible in his time. Our description of his doctrines follows in essentials his *Medicina catholica.*[4]

The absolute unity of the world in God is the foundation of Fludd's system. God clearly appears as the chief chemist with nature as His laboratory. The truly wise man daily observes the work of His creative word, which, partaking of the nature of light, bestows origin and forms in the heart of the elements. It works "conveniente arte spagyrica." Thus our chemistry is simply an imitation of

[4] Francofurti, 1629.

divine creation in nature. Chemistry is both the search for God and the vision of God. It is " philosophia naturalis " and therefore theology. In the destruction of the specific individual form resulting in the general higher form it represents union with God.

Therefore true practical theology is nothing but mystical chemistry which furthers our attempts to uncover the divine light for our own benefit. The study of nature is the " mons rationalis " leading to paradise. Its aim is not the making of gold, but the cognition of things as realities, and of the truth. This rests with God alone as the true " perfectio." But since there is nothing in nature which He is not, a knowledge of nature leads to His truth. It is our right and duty to investigate nature, because His justice and truth exist on account of our justice and truth. " My truth will make known your eternal truth."

Access to nature is given by simple experience, which recognizes the healing power in the organs of the body (e. g., of pulverized skull bones) and demonstrates that by means of great concentration things may be perceived happening at the most distant places, two ideas of epoch-making importance, subjects of systematic dispute.[5]

This mystical view of the world which denies the importance of reason, accepts a pseudo-rational element in biology and medicine by the employment of astrological and mathematical deductions. If all being is dependent upon matter receiving form, the number three is of peculiar importance. It is the " principium formarum." Two lines make neither form nor figure. Therefore the triangle is the basic figure which cannot be resolved into other figures. Three is the number of the Godhead, consisting of God the Father, the " causa efficiens," the representative of matter containing the potentia of formation, God the Son, the " causa exemplaris," the representative of sapienta, the origin of forms by virtue of logos and idea, and finally the Holy Ghost, the " causa finalis " and " conservans," the representative of goodness. Hence the number three is nearest to the essence of God and therefore to perfection. It permits man to approach God's infinity, and, as the result of its most wonderful and secret truth, it conveys (" insinuat ") into

[5] Compare the account of the contemporaneous quarrel " de magnetica vulnerum curatione," Pagel, *van Helmont, loc. cit.*, p. 96 ff.

things the cause and principle of universality, which is absolute unity incompatible with diversity. On these theories is erected an arithmetic complete to the last detail of prognostication, which forms the principal part of the medical section of his work.

If the world is a unity and God infinite, Fludd is equally justified in having taken the stars and their courses as the measure of all "sublunary" things, and in having employed the principles of mechanics in order to provide a uniform explanation of natural processes including biology and pathology. Hence Fludd's neoplatonic mysticism finally resolves itself into a *simple mechanistic view*.

God influences things by means of his instruments, the angels, the essence of whose activity is the "Jesus spiritualis," the eternal wisdom which distributes forms and ideas, and is identical with the glory of the emanation of the eternal light. One of the most important of the angels, according to cabalistic tradition which Fludd accepts, is Michael, who commands the winds.

As mediators between God and nature ("virtus media") the angels perform all operations inaccessible to human reason which are the effects of the "proprietas occulta" in the things.

Matter is derived from the primary element, water. This hypothesis is based on the biblical story of the creation, and corresponds to the theory of van Helmont, etc.[6]

But matter never is the first cause. It obeys the word of God borne by the winds. These are the *causes* to which the student of nature must penetrate. The various winds are derived from the various characteristics of God, thus the east wind is "ex parte clementiae et miserationis," the north, "ex parte iudicii et severitatis," and in accordance with their origin is the result of their influence and their commands.

But the action of the winds on matter is not direct. As a rule they make use of special "Principes elementorum," immanent in elementary matter, i. e. demons, which, aided by the wind, change the air "in suam naturam." This is in accordance with the belief, common to all mysticism, that material changes are due to the trans-

[6] Compare Joel, *loc. cit.*, p. 56, who points out the agreement of all mystic cosmologies, especially those of the presocratic thinkers (Thales), with regard to the importance of water.

formation of matter by a dynamic principle into something resembling itself.

Fludd's demons are nothing more than the elements of the ancients which, without examination, he accepts with all the characteristics attributed to them since antiquity. The only difference is their spiritualization, which is achieved by the simple device of personification with the object of depriving matter of its preëminence: accordingly, Samuel is the spirit of fire, Azazel, of moist air, Mahazael, of earth, and Azael, of water.

Man was in absolute unity with the Divine until the fall of Adam. Adam was able to comprehend the essential nature of all things. The Fall was in the sphere of the number two. This was the beginning of all polarity and all extremes, such as light and darkness, activity and gravity.

Polarity conduces to the maintenance of stability in the sphere of comparable things, which, according to the well-known tradition from St. Augustine and the Areopagite until Kues, are equal in the infinity of God.

The doctrine of polarity is the source of our knowledge of the parallelism existing between *mac*rocosm and *mi*crocosm and decisive for all natural processes. Thus it is the basis of the whole of natural science.[7] Such universal analogies are

Heat-Movement-Light-Dilatation-Attenuation
Cold-Inertia-Darkness-Contraction-Inspissation

Sun-Father-Heart-Right Eye-Visus-Sanguis vitalis
Moon-Mother-Uterus-Left Eye-Mucus.[8]

As a result of the emphasis of the absolute unity of the world in God and this legitimate parallelism, in spite of his belief in the essential spirituality of things, Fludd arrives at a universally applicable mechanistic explanation. Therefore, his view of the world, which is a religious monism, a kind of philosophy of identity, gives

[7] See Giordano Bruno, *Della caus. princ. et uno*, transl. Seliger (Leipzig, 1910), p. 191. Whoever wishes to investigate the deepest secrets of nature, might observe the "Maxima et minima" by means of comparison with the opposite and contradicting entities. It is a profound magic to be able to produce the opposite after having discovered the point of conjunction.

[8] Compare Ptolemaios, *Tetrabibl.*, III, 11.

rise to a purely mechanistic theory, which itself is based on a uniform principle.

This principle is that of expansion and contraction. Since it is the key to the explanation of the world, Fludd calls it "Universale naturae in raro et denso mysterium."[9] The knowledge of this is derived from experiment, a "speculum experimentale," from which Fludd has deduced the general laws governing the behaviour of all natural objects, and has come to the conclusion that the activity of even the smallest atom is comparable with the activity of God.

The universal instrument demonstrating this mysterium is something between a thermometer and barometer to which we have already referred.[9a] It consists of a trough filled with water in which stands an inverted air-filled retort. The neck of the retort, which is immersed in the water, has graduated markings. When the globular end of the retort is warmed, the air within expands and displaces the water in a downward direction. The amount of this displacement can be read from the graduated marks on the neck. Conversely, the action of cold causes the water to rise.

The world of matter which we observe by the aid of this instrument, whether expanded or contracted, is always the same. Cold and heat are not differences, but merely degrees of a single quality. The

[9] Compare Fr. Bacon, *Hist. de ventis, loc. cit.*, p. 114: Historia densi et rari. Because the sum of matter always remains the same the expansion and contraction of the bodies is of greatest importance in order to avoid a vacuum. "Cum igitur sit res (si qua alia) *plane fundamentalis et catholica* . . ." Similarly according to Joseph Needham, *Chemical Embryology* (Cambridge, 1931), I, p. 130. Sir Kenelm Digby refutes all qualities and "faculties" in biology and like Galileo and Hobbes refers to a universal explanation of *two* virtues only, those of *rarity* and *density* which work by means of local motion. "Two treatises, in the one of which the Nature of the Bodies, in the other the Nature of Man's soul is looked into: in way of discovery of the Immortality of Reasonable souls." (London: Williams, 1663), p. 253. Compare Telesius, *De rerum natura juxta propria principia*, Prooem. I, 1 ff., and III, 34: "All natural effects are to be derived from heat and cold; their continual combat causes the different degrees of contraction and expansion by means of which matter appears."

[9a] The instrument described resembles Galileo's thermometer, the invention of which goes back to 1602. See J. J. Fahie, *The scientific works of Galileo*. Ch. Singer's *Stud. Hist. Meth. Science*, II, 1922, p. 219: "It was in truth a barometer as well as a thermometer, although Galileo did not recognize this." Compare the similar instrument constructed by van Helmont, and described in his treatise "Aer" 12.

air within the retort is not subjected to attraction in the sense of Aristotle; but there is active expansion and contraction of this active, because spiritual, element. Hence, even the great natural phenomena like wind, clouds and rain, are to be explained as the result of evaporation and condensation and not as the result of an attraction of the rarefied parts of water and air by heat, as Aristotle assumed. For the task of heat is not attraction but rather "pellere et propulsare." But if everything in the world occurs only on account of the evaporation and condensation of ever constant matter, there must be absolute conservation of matter. Therefore, there is no destruction.

The whole of Fludd's natural science and pathology is permeated by the ancient doctrines of the elements and humours which he actually accepts in their entirety and elaborates to the last detail. He even adheres to the belief of the ancients in the transformations of the same matter. Nevertheless, he emphatically states his fundamental *opposition to antiquity*. The ancients have missed the real causes, observing in their elements and humours only secondary causes. These correspond to the dead instruments used by the living winds as composers. According to Moses and Hermes, his most important sources of knowledge, everything consists of one thing only: water. Cold, heat, moisture, dryness are not qualities immanent in things; they are contained by the essence of the momentarily active angels, whose manifestation, as we have seen, is immediately dependent upon the divine influence.

With reference to individual points, Fludd is mainly concerned in refuting the ancient doctrines of crisis and pulse. The first is the result of inaccurate empiricism ("sine ulla ratione radicali"). Its chief error lies in the lack of consideration given to the true movements of the stars, the knowledge of which, derived from new charts of constellations, has made possible an entirely new system of prognostication.

Therefore Fludd is far removed from the decided rejection of the ancients, characteristic of Paracelsus and van Helmont, even though he, also, imagines himself as the creator of entirely new principles and the discoverer of the true cause of things.

Fludd's biology is based upon the hypothesis that life signifies

participation in the world of ideas and forms, that is, in the universal soul. Life is therefore endowment with the specific function — species — and the faculty of reproducing this species. That the universal soul, in this sense, actually does exist, and that everything in reality is filled with God and ideas are proved by the fact of spontaneous generation, which refutes those who, like Fludd's opponent Mersennus, deny the existence of the universal soul.

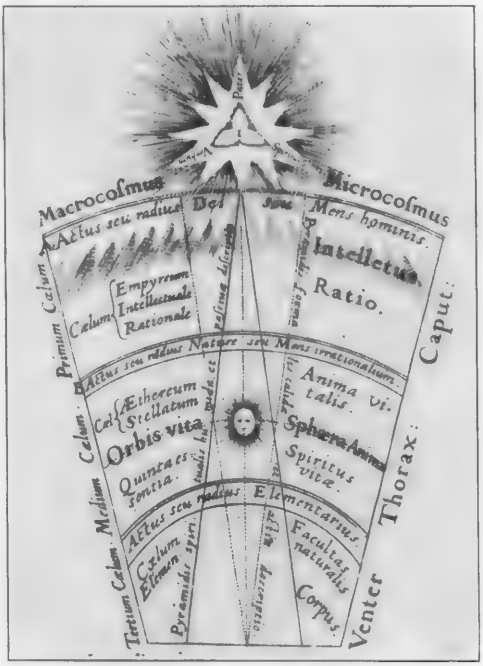
Man, as a microcosm, contains within himself all parts of the macrocosm. Hence in him there are all stages of transition from matter to spirit. Since the world forms a ladder of the emanations of the Divine Being, life and soul in the human body are the rays of a higher sphere than the elementary sphere it contains, and these rays are the origin of the functions. Like the world, the body can be divided into an upper, middle and lower region. In the upper region predominates the superior, that is, the finest corporeal element, fire.

The middle region of the body, wherein heat and moisture prevail, corresponds to the element air, while the lower region producing chylus in the stomach, blood in the liver, and urine in the kidneys, corresponds to the element water. The more closely woven the tissues of the organs, the denser the spiritus which they produce. The spleen and the intestines excrete a pitch-like substance, the heart, the vital and almost invisible spiritus which is diffused by means of the arterial blood; the brain, the usually invisible rays resembling light.

The unity of the soul maintains harmony in this body, protecting it from diabolical duality, and therefore disintegration. Harmony expresses itself in the form of the metrical laws of music.

Just as the ancient elements play an important part in the whole of Fludd's philosophy, his biology is also based on the doctrine of complexion. From this the principal element of an individual body may be determined, and hence the constellation decisive for the individual. The close connection of the whole of Fludd's system with astrology demands such a study of temperaments and complexions. The predominance of black bile directs the attention to Mars, and the appropriate therapy in disease has to obviate the influence of this planet. Hence suitable medicinal herbs must be collected at the time when Mars in on the wane.

On the principle of his universal instrument, the thermo-barometer already described, Fludd explains temperament as the result of primary alteration in the temperature of the body. If this rises, the air in the body expands causing the movement of the



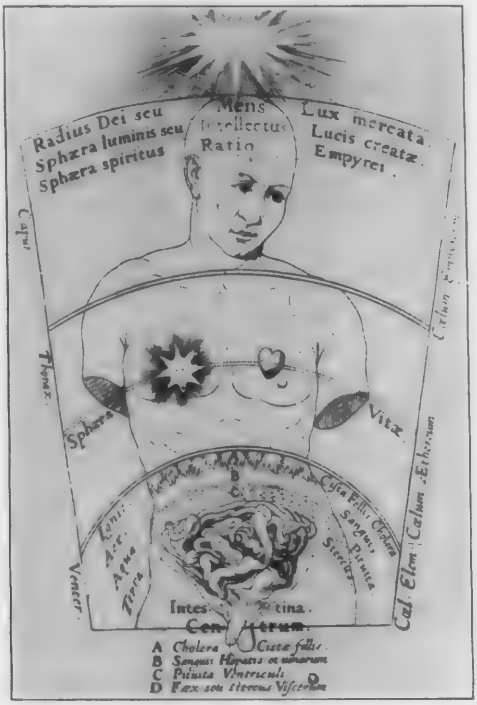
CORRESPONDENCE BETWEEN THE REGIONS OF THE BODY AND THE WORLD

From Fludd's *Medicina Catholica*

Compare the pictures in Charles Singer, "The scientific views and visions of Saint Hildegard," *Stud. Hist. Meth. Science*, I, 1917, p. 43.

humours. Then the relatively thin humor, black bile, predominates, giving rise to anger, heat, liveliness, nimbleness, fantasy, wakefulness. As an equator denotes, in the model, the balance of heat and cold, so, in the microcosm, it indicates the balance of bile and mucus. Therefore, there are only two temperaments, which are distinguish-

able according to the rise above or fall below the equator. Thus, also, according to the standard of the instrument, there are only two diseases of the body as well as of the soul. The deviations *above* the equator, denoting condensation of the air and the rise of the water,



CORRESPONDENCE BETWEEN THE INDIVIDUAL ORGANS AND THEIR FUNCTIONS AND THE PARTS OF THE WORLD

From Fludd's *Medicina Catholica*

correspond to the predominance of mucus, which gives rise to epilepsy and all kinds of paralysis. The deviations *below* bring in their train bilious complaints and abnormal heat, of which inflammations, erysipelas, gangrene, pleurisy, are the signs. Fury and fear are the corresponding extremes in the spiritual sphere. Health consists " in

temperamenti iustitia vel pondere." It embraces all vital functions in as far as they can be implied by " iustitia et perfectio." Disease signifies all manifestations of the vital functions when they are checked in their activity, removed from " Perfectio," or in any way debilitated or diminished.

The principle of polarity also explains the physiology of the pulse and the circulation of the blood. Expansion and contraction of the heart, as well as the parallel functions of inspiration and expiration, are manifestations of the polarity of the vital spirit causing function. And ultimately even these polarized fundamental functions are traceable to the contradiction between heat and cold. To the cold breath of the spiritus there is a corresponding contraction of the air, a rise of the water in the thermometer and systole of the heart, while conversely we find expansion and diastole. The normal pulse follows the laws of harmony in music, while the abnormal pulse, like all sickness, is dependent upon the influence of disease-bearing winds. If the east wind is the cause of the abnormal rise of temperature, the pluse is broader and palpable to four fingers. The pulse varies according to the phases of the disease and the corruption engendered by the heat of its cause in the part of the bodily substance which this attracts. The riper the pus, the calmer the pulse — a purely humoralistic and galenic theory which Fludd explains diffusely. The hard pulse is due to the north wind, which condenses fluids so that water hardens into snow and hail. Such a pulse we find in the tartaric diseases of Paracelsus, wherein the organs contain solid deposits representing the true anatomical change.

The result of this generally symbolical and analogical point of view is Fludd's definite acceptance of the new theory of the circulation of the blood. Like the world in its orbit, the blood circulates in its vessels, obeying the systole and diastole with a movement resembling the ebb and flood of the tide.

Such considerations confirm, according to Fludd, " exacte " (sic) the " sententia et opinio " of his friend, colleague and compatriot, Harvey, who was well versed not only in anatomy, but also in the deepest mysteries of philosophy. The theory which he demonstrates " consulte et prudenter . . . cum rationibus a philosophiae arca de-

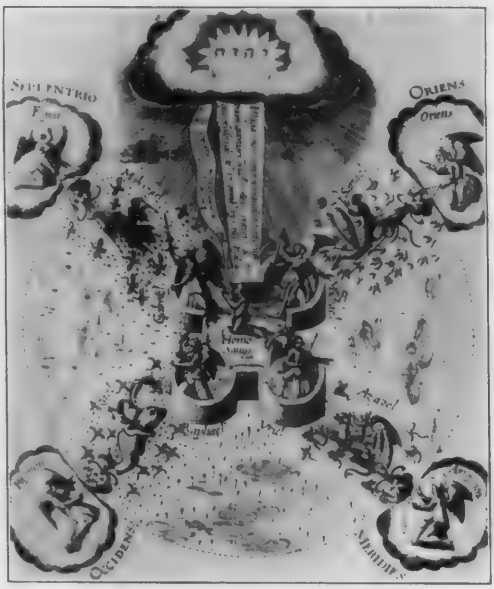
promptis, tum multiformi demonstratione oculari" is that the movement of the blood is circular. How could it be otherwise, since it is absolutely certain that the spirit of life retains an impression both of the planetary system and of the zodiac? Thus, as the moon follows her unchanging path completing her journey in a month, she incites the spirit of the blood, and therefore the blood itself, by virtue of its "astra imperceptibilia," to follow in a cyclical movement. Every seaman is acquainted with the influence of the moon on wind and tide. Why should she not exercise a similar influence on the "microcosm" of man?

Like his biology Fludd's pathology is a strange mixture of humoralistic doctrines with ontological and aetiological ideas. As has already been shown, Paracelsus developed the ontological conception of disease by means of which he ousted the ancient humoralism. The new estimation of the external causes of disease and its localization in different organs caused a revolution in the ideas on the subject. Disease came to be regarded not merely as the one pathological condition [10] recognized by antiquity, varying on account of the differences of the properties of the individual organism involved, its mixture of humours, its temper and constitution, but as numerous pathological conditions all differing and classifiable according to their diverse causes and their respective seats. Fludd's medicine, which pretends to be a "medicina catholica," combines both points of view. Adhering to the ontological doctrine, he maintains that the cause of disease represents the essence of disease, and taking into consideration both the ancient belief in the influence of harmful exhalations (*Galen*) and the emphasis laid by *Paracelsus* on the importance of an aerial chaos of finest corporality, he decides that the causes of disease must be the *winds*.

In accord with these conceptions of Paracelsus, Fludd assumes the existence in the atmospheric chaos of "spiritus mali" and invisible seeds ("Seminaria invisibilia") which penetrate into the body through the lungs and through the pores of the skin. Individually they partake of the characteristics of fire, earth, or moisture. In this idea we perceive the return of the ancient humoralism as an

[10] See my *J. B. van Helmont*, p. 112 ff.

essential constituent of Fludd's system, by which he is to be distinguished from Helmont. Moisture causes infections such as plague, measles, small pox and phthisis. Atmospheric substances with the properties of earth cause melancholy, stupor, as well as chronic infections, such as leprosy, scabies. Moist substances origi-



THE "HOMO SANUS" PROTECTED BY THE ANGELS FROM THE WINDS WHO, USING DEMONS AS MESSENGERS, SEND THE CAUSES OF DISEASES

From Fludd's *Medicina Catholica*

nate conditions like apoplexy and epilepsy. These causes of diseases are personified as the demons Samael (fire), Azael (moisture), Mahazel (earth) and Azazel (water), who make use of the winds in order to approach their object, the human body. Wind is, in this sense, the corporeal basis of all activity and new creation derived from the Logos. The winds are in the custody of the angels who may hold them fast or set them free. Thus the origin and develop-

ment of disease are closely connected with the activity of the Deity. On the other hand, God does not create disease any more than the blacksmith, when modelling iron, creates the rust; disease is a mere by-product of creation, " consequitur creatum."

The pathological process originates in the condensation of air to a humour in the body. This humour influences either the blood or the flesh, just as the wind affects either the sea or the land.

Fludd illustrates the process by means of a simple mechanical device. A basin is horizontally divided by means of a diaphragm pierced in two places. Sand is poured through one of the holes with the result that the air, thus expelled from the lower part of the basin, escapes through the second hole. This air, having been dried by the passage of the sand, has properties resembling those of the north wind, for it is the north wind which conveys air with earth-like characteristics. When the north wind prevails, drought and cold predominate because of the addition of earth to the air. The same principle applied to mar. signifies that the air in the intestine comes into contact with particles of earth derived from the spleen, the tumefaction of which causes the earth-saturated air to rise, and this is the origin of melancholy.

By a similar mechanical construction Fludd demonstrates the development of catarrh and many other diseases. The different diseases are attributed to certain changes in the humours, caused by the prevailing winds. Leprosy and elephantiasis, which, judging by their external appearance, depend upon a condensation of humours, are ascribed to the congealing influence of the *north* wind. In accordance with this theory the *east* wind has a stimulating effect on bile and its corrosive properties. Thus acute inflammations such as dysentery, pleurisy, pneumonia, herpes and acute bilious complaints are some of the effects of the east wind.

Fludd has associated this doctrine of the causes of disease with the hypothesis of the decisive influence of the stars on men. Immediately subjected to the stars is a " Sal volatile " which is present in the air, and, according to the doctrine of Hippocrates and Galen, is attracted to the heart and brain, wherein it maintains the spark of life, this is the immediate seat of the human soul, as well as of the soul of the world, of which the former is only a part and emanation.

Thus it is a " Sal catholicum." All motion, whether in the macrocosm or in the microcosm, in air, sea, or earth, depends on the behaviour of this substance. The motility of the blood is due to its presence. In the human organism excessive expansion or commotion of the sal produces sweat and fever. Since the movements of the sal depend upon the will of God, fever must be regarded as a Divine message. The sal in the body undergoes innumerable changes. It is excreted as an ammoniacal earth salt in the urine, and, as such, is also obtainable from the bones, flesh, and blood. It decides the nature and properties of the urine. If it has a tendency to expand and to extend its own property of dilatation to other substances, the urine is darker in color. If it has a tendency to contract, the urine is paler.

This idea of the " sal volatile " as the origin of all motion apparently differs from Helmont's doctrine of the " Blas " [11] only in so far as it contains the suggestion of a material basis.

Fludd's *therapy* is the outcome of his firm belief in astrology which makes possible, on the one hand, a pedantic prophylaxis, and, on the other, a choice of remedies in accordance with the ascendant constellation. The general principle employed is that of " Contraria contrariis." The cause of disease brought by the wind " A " must be combated by remedies which have the properties belonging to the wind " B." Fludd, especially when confuting his rival Mersennus, points out that therapy is a part of magic.

Fludd's prognostication and semiology are an elaborate arithmetical mysticism, which is too complicated for further description.[12]

Fludd's system is, according to his own claim, a " Medicina catholica." In fact it embraces all conceptions of disease possible during his time: humoralistic and ontological theories, iatrochemical and iatromechanical designs, religious and metaphysical, as well as physical, chemical, and purely biological elements. By means of a dexterous employment of the analogies existing between macrocosm and microcosm, Fludd subordinates the heterogeneous elements of the philosophical notion of uniformity to the universale mysterium

[11] See my *J. B. van Helmont, loc. cit.*, p. 67.

[12] Compare the connection of arithmetical with geometrical and astrological mysticism in John Dee's *Hieroglyphica ad Maximilianum regem* (Francof., 1591).

which he sees in the faculty of the universal soul to expand and contract.

In Fludd's system, almost the whole of the ancient tradition of analogies in macrocosm and man is restored, which, according to the studies of Charles Singer,[12a] is expounded in the anthropology of Hildegard of Bingen and can be traced to the old Iranian cosmological physiology (Liebeschuetz). The " Kosmos-mensch " and the analogies of the regions of the human body with the parts of the whole world are the corner-stone of Fludd's system, as man is the centre of Hildegard's vision of the cosmos. The peculiar proportions of the man in the centre of the world, whose span is equal to his height, because the length and the width of the heavens are equal, are reconsidered by Fludd and illustrated by a special picture. Fludd's accentuation of the winds as the power governing the movement of the world and the stars, according to Liebeschuetz, is also derived from an Iranian or Hermetic source.[13]

The main features recognizable in Fludd's philosophy are:

(1) The adoption of the then " modern " ontological idea of disease. Disease is the " meteoron morbosum," that is, the morbid influence from without, which is closely connected with astral influences and the climatic effect of air and wind (" Meteoron ").[14]

(2) The inclusion of the whole humoralistic ideology as a dogmatic fundament of his system.

(3) The invention of various mechanical models to illustrate the mutual displacements occurring among the elements under the influence of a " sal volatile " which is inhaled and induces motion.

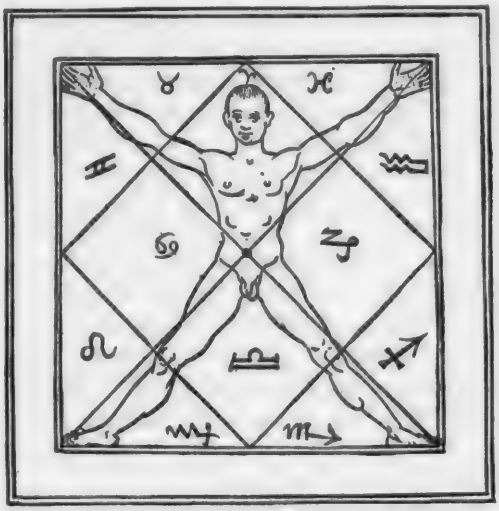
[12a] " The scientific views and visions of Saint Hildegard," *Studies in the History and Method of Science*, I, 1917, 1-55, espec. p. 43 (comparison of Hildegard's and Fludd's pictures).

[13] Liebeschuetz, H., " Das allegorische Weltbild der hl. Hildegard von Bingen," *Stud. d. Biblioth. Warburg*, XVI (Leipzig u. Berlin, Teubner, 1930), pp. 86 ff., 81 ff., 12 ff. L. refers to the paper of A. Goetz, " Persische Weisheit in griechischem Gewande," *Zeitschr. Indologie u. Iranistik*, II, 1923, 60, 167 ff.; Mich. Scotus, the Hermetic Asclepios and Ptolemaios. On the medieval tradition of the doctrine of the power of the winds (Isidorus, etc.) see Singer, *loc. cit.*

[14] " Quod iuxta intentionem nostram non sit inter meteoron insalubre et morbum discrimen." *Med. cathol., loc. cit.*, II, p. 76.

Thus Fludd pursues the method of analogy even in the details of his mechanistic explanation of the life process.

(4) The association of religious ideas with the mechanistic explanation of natural processes typical of the period of Baroque is demonstrated by such a figment of the imagination as "the winds,



THE "KOSMOSMENSCH" IN THE CENTRE OF THE WORLD WITH HIS PECULIAR PROPORTIONS
(Span equal to height)
From Fludd's *Medicina Catholica*
Compare the graphic tradition of such "Melothesiai" in Ch. Singer's "The scientific views and visions of Saint Hildegard," *Stud. Hist. a. Meth. Science*, I, 1917, p. 43.

as the messengers of God, govern the air and influence its behaviour by transferring to it the commune mysterium of expansion and contraction."

(5) Finally, an essential feature of his doctrine is the purely cabalistic mysticism of numbers which culminates in his prognostication, his diagnosis from the difference of the strata of the urine in a glass, his doctrine of pulse and fever, and his therapy.

The study of Fludd's works immediately suggests a comparison with those of his contemporary Helmont. Both make use of analogies, but while this method of research with Fludd results in mere fantasy,[15] it has led Helmont to an extraordinarily well-founded vitalism which approaches reality. Both uphold the ontological conception of disease, the dogmatic entities of Fludd's system, the *winds*, being represented in Helmont's biology by the *gases*, which he discovered and connected with the doctrine of the contagium. While Fludd accepts the humoralism of antiquity without reservation, Helmont rejects both this doctrine and the ancient assumption that heat and moisture are the origin of life, demonstrating the vital functions as chemical processes. Therefore the comparison of these two authors appears to emphasize the achievements of Helmont showing that Fludd's doctrine deserves an historical interest only, because it reveals most clearly the religious ideas which inspired a mechanistic explanation of life and disease. Such an estimation is based upon present day standards and is unjustifiable from a historical point of view. Fludd and Helmont are products of the same epoch in the history of the human mind, and each has constructed a natural science which is subordinated to religion, the one more in the direction of the pantheism of the Renaissance, the other showing the tendencies of Christian mysticism.

Fludd and Helmont were children of the XVIIth century, the " reign of law " (Ch. Singer).[16] Therefore the idea of the harmony of the world, and the law of equality which governs it, finds its echo in their works. There are conceptions drawn from civil and legal affairs which both authors transfer to the sound and the sick organism. In the writings of Fludd, especially, such analogies are emphasized. " Justitia " is his expression for the " Perfectio " which is represented in the combination of the material (materia potentialis) with the ideal (lux formalis), a combination which is also a fundamental principle in Helmont's conception of the world. The " temperies vitae," that is to say, normal life, is destroyed, if the laws of divine justice, as represented by the harmonies in living

[15] Reasonable sentences such as: " In paralysi solent medici periti febrem martialem incitare " are rare.

[16] Singer, Ch., *A Short History of Medicine* (Oxford, 1928), p. 135.

beings, are violated. The " imperium " of health is disturbed and civil war (bellum intestinum) breaks out. During the time of peace, maintained by the physiological processes, concordia unifies the members of the body; if this harmony is absent, the autonomy of the body is unsettled by internal warfare and altercation " ita ut omnis iustitia ab illa oeconomia excludetur." Disturbance of this " Ligamentum pacis " in the body is an expression of a disturbance of the " nexus amoris antiquissimi " by which God, Logos and all creation are united.

The harmony of the body is the basis of its functions which originate in its anatomy, its " ratio constitutionis." It is the injustice of our sins which causes the disorder and strife, the injustice of our internal economy. Therefore disease is identical with uncleanness, sin, injustice. Like a judge in a court of justice, God decides on the critical days the life or death of the patient. " Ablato peccato," a paralytic recovered immediately.

Thus there is a " mysterium dierum criticorum." The number seven (= 3 plus 4) indicates the abolition of contradictions, being the expression of a combat between cleanness and uncleanness, light and darkness, beauty and ugliness, corpulence and emaciation, good and evil, life and death.

The crisis signifies the expulsion of the enemy from the invaded country. Similarly Avicenna has referred to the crisis as " separatio litigantium."

Like a regent, the beam of God in the seed governs the creation of the new organism.

The examples of such analogies taken from the civil and legal life could be increased. Their employment, which we also find in the writings of Marcus Marci, seems to be a typical feature of the biology of the period. According to Helmont the vegetative impulses derived from the centre of the organism have the same influence on the organs as the " nutus potestativus " of a guardian on his ward. They are not transmitted by material processes [17] and are like the command of an absolute dictator. Thus every effect due to any archeus is a " *potestas.*" Disease is a " potestas peregrina " which is

[17] See van Helmont's treatise, *Ignota actio regiminis* and my *J. B. van Helmont, loc. cit.*, p. 68 ff.

foreign to the aims of the organism and therefore noxious. It subordinates the archeus of the organism to its own rule, forcing it to suffer war in its own country.[18] Similarly, according to Marci, the archeus of the body is subjected by the sting of the tarantula " alienis legibus."

Fludd's whole doctrine depends upon the fundamental conception of unity in the world. Thus the construction of analogies is his general method and his source of knowledge. It is the same sequence of ideas which characterizes the philosophy and biology of the romantic movement in the early 19th. century. This sees all things in the world, both corporeal and spiritual, as different aspects of the same unity. Spirit is but the highest degree of development in nature by means of which nature recognizes herself. Therefore, by its own method of speculation, spirit is enabled to apprehend natural processes in their true essence. The vision of parallelism and analogies in nature and in spiritual life is the paramount method of attaining to natural science. The idea of polarity and the deduction of all processes from one principle, that of the reconciliation of fundamental contradictions, such as light and heaviness, are the basis of this natural philosophy.[19] Contemporaneous experiences are combined with the construction of analogies to form a medicine or biology similar to that of the " Medicina catholica " of Fludd. As a matter of fact sentences taken from J. W. Ritter's Fragments,[20] which are definitely typical of the romantic movement, could be mistaken for excerpts from Fludd. E. G. " According to heat ▲ equal to force of expansion and cold ▼ equal to force of attraction, the limitation of both, matter, could be signified by ✡.[21] " Water is the chemical octave, the tones of which are the primary elements, and the chemical combinations of which are the accords.[22] " In order to produce substances, the contradictions must be restored, e. g. that

[18] Helmont, *Ortus imaginis morbosae*, 2, and my *J. B. van Helmont, loc. cit.*, p. 91.

[19] Compare my *Virchow und die Grundlagen der Medizin des XIX. Jahrhunderts* (Jena, Fischer, 1931), p. 10.

[20] *Fragmente aus dem Nachlass eines jungen Physikers. Ein Taschenbuch für Freunde der Natur* (Heidelberg, 1810). I am greatly indebted to Professor Martin Buber for having made me acquainted with Ritter and his work.

[21] Ritter, p. 33, No. 48.

[22] P. 39, No. 65.

of the sexes to the time in history when he, when she, really originated in the development of the world. It is a real cancellation of time, or, a putting back of the clock, and every organic creation is due to such a process. Nature is constantly referring to the time of creation. The higher the development, the further she has to go back." [23] "Every formation is due to polarity in space." [24] "Everything is a degree of a great scale: atmosphere — the world of plants — the world of animals — inanimate nature." [25] "Each drop of rain is a world, the dew contains many planets, the air is a sea full of celestial and terrestrial bodies." [26] "All force originates in polarity. Just as the sum of the living forces remains the same, the sum of living polarities does not change." [27] "Not history of physics but history *equal* to physics equal to history." [28] "The age of things seems to be expressed by their ability to be extended. Metals are very difficult to extend and they extend homogeneously. They are the oldest entities in the world. Then come salts, water, air, vapor. The last contains the force of youth, the first the rigidity of age." [29] "All individuals in nature are mediums of refraction for all beams of the universe. In man the beams of God are refracted, they are broken up, their colours being the harmonic interplay of his thoughts. It may be said that some thoughts originate in rays with a rectilinear course and that others are due to deflected rays. The heart is the rectilinear beam of God to man. The true man is the heart, because all the external world is refracted here. Life is a play of colors. Man should not take any color singly, when all are combined the complete picture of God is produced in him, as it appears in love, which is but the joy, love experiences in itself." [30] "Light is a contagium, it 'infects' space and space becomes light. Light is the highest organization with the lowest individualization." [31] "Tones originate in vibrations which return in equal units of time. Half the number of vibrations in the same time produce a tone an octave lower. Finally, there appear vibrations which last a day, a year, a life-time. We ourselves, and plants and animals, and, indeed, all life, may be comprised by such tones. Tone and life here

[23] No. 70.
[24] No. 76.
[25] No. 78.
[26] No. 83 B.
[27] No. 88.
[28] No. 170.
[29] No. 225.
[30] No. 256.
[31] No. 272.

become unity. In the future it will be of greatest interest to know the relation between the tone produced in the body by swallowing, the pulse, etc., or Volta's column and those large fundamental tones, or any one of them. The string of this fundamental tone will be the earth, whose density and velocity will determine the physical properties of the tone. This music might be heard as harmony only in the sun. The sun, like the whole planetary system, is a musical instrument." [88]

These examples from one typical exponent of the whole movement are sufficient to demonstrate the similarities in the fundamental view. It is the same method of finding analogies between all things and all forces in the world, which about 1820, as well as two hundred years before, in the writings of the followers of Paracelsus, forms the basis of natural science. How far the similarity goes, is demonstrated especially by the importance assigned to light and its beams, and their relation to man. It is the same fundamental conception which is elaborated by Marcus Marci in his speculative embryology. But the phenomena can be equally well observed as particular relations of tones and harmonies or as electric and magnetic phenomena. In this way Fludd endeavoured to work out from a knowledge of harmony the principles underlying the explanation of the similarities in macrocosmic and microcosmic phenomena. This parallelism between romantic natural philosophy and the mysticism of the XVIth and XVIIth centuries, as well as the ancient stoic and neo-platonic doctrines, is so obvious that it is recognized by the epoch of natural philosophy itself. Bouterwek observed the analogies and found the origin of this " materialization of reason and intellectualization of nature " in Aristotle's doctrine of the soul.[89] But Aristotle was a sober thinker, and it was not before his natural metaphysics was altered in Alexandria and by the Arabs (Abu Tschafar Ebn Tofail) that the vision of the absolute was connected with a state

[88] No. 360. Compare Novalis, who, in his " Fragments " applies the laws of harmony to the human body (*Schriften*, ed. Tieck and Schlegel, 4. edit., Berlin, 1826, II, p. 125). " Every disease is a musical problem, recovery a musical resolution; the shorter and more complete the resolution, the greater the skill of the physician."

[89] " Erinnerung an die Naturphilosophie einiger Arzte, Kabbalisten und Rosenkreuzer aus den vorigen Jahrhunderten," *Neues Museum der Philos. literat.*, 3, 3 (Leipzig, 1805).

of ecstasy, in which were realized the relation of the human soul to the stars, the identity of the Ego, as the recognizing subject, with the recognized object, and the power of recognition. Unity was seen in multiplicity, the individual was united with God. Bouterwek also referred to the correspondence between this doctrine and the doctrine of the soul of the world outlined by Averroës, the hylozoism and pantheism of Cesalpino, a follower of Aristotle, the metaphysics of light imagined by Patritius, the conception of Paracelsus and the sense of reality of this "kraeftigen Schweizers." Finally the philosophy of Leibniz is also said to have developed into pantheism and a doctrine of emanation because of the deduction of nature from absolute unity and the cancellation of the dualism of reason and nature. Fludd is mentioned as the forerunner of the idealists of the early XIXth century, because he differentiates between the forces of expansion and contraction and even goes so far as to call expansion the south and contraction the north of the universal.

The relations of romantic natural philosophy to Paracelsus and van Helmont are also shown by the renewed interest in these two authors.[84] J. M. Leupoldt,[85] one of the last exponents of natural philosophy, in his appreciation of Paracelsus and Helmont, expresses the opinion that it is unwise to deprecate doctrines only because they belong to the past. Their doctrine was, in their time, a just as necessary and natural expression of the inquiring human mind as any other, such as sophism, scholasticism and mathematical deduction, etc.

The romantic natural philosophy of the early XIXth century and the religious natural speculation in the XVIIth century have in common not only the general tendencies regarding the conception of the world and nature, but also the doctrine of normal and pathological life. Although the speculation on a special force of life as the distinguishing characteristic of living beings belongs to the romantic era, the same era is also marked by an equally strong distaste for such speculation. The origin of the reluctance to predicate a special

[84] See Lessing, Mich. Ben., *Paracelsus: Sein Leben und Denken* (Berlin: Reimer, 1839); Preu, Th., *Paracelsus* (Leipzig, 1838); Sudhoff, "Paracelsus-Bibliographie," *Acta Paracelsica*, I (München, 1930).

[85] *Die alte Lehre von den Lebensgeistern* (Berlin u. Leipzig, 1824).

force of life is to be found in a disinclination to interrupt the vision of nature as a *unit* by the introduction of a peculiar force in living entities. Thus Goethe sees the disappearance of the contradiction between the organic and the inorganic in a vision of a " Natura naturans " which is recreated in the mind. The creations of this nature are not fundamentally different from the act of spiritual knowledge. Nature in this sense " knows by magic." [86] Similarly, our knowledge of natural processes is identical with the production of the natural phenomena themselves. It is in this sense that Novalis declares: " All experience is magic and can only be explained by magic. Empiricism ends in a unique idea. . . . The active use of the organs is nothing but a magic mode of thinking which performs miracles, or an arbitrary use of the corporeal world; just as will is nothing but the vigorous magic power of thinking. The " physical magus " knows how to animate nature and to treat her arbitrarily as his body." [87]

As long as we lack valid proof that forces other than chemical forces act on the living body we are not justified in assuming new forces. (Ritter,[88]) It is the specific gravity of an organ which, according to Ritter, determines the quality and intensity of the vital functions. The higher the specific gravity of an organ, such as bones and nails, the slower the vital processes. If, supposes Ritter, referring to Kant, the decomposition of water is the vehicle of psychical activity, and the fundamental forces of life are included in water in a state of rest, it is possible that the Ego in its life activity acts upon the force of the decomposition of water.[89] Fr. von Baader also regards fluid as the basis of life. Fluid is the endowment of every living being as its innermost-heart of the heart, brain of the brain — animating the body, which otherwise is only a skeleton.[40] Accordingly Ritter considers the expression of the highest vitality as that with the lowest degree of cohesion, because this has to overcome the least individuality. The gases are nearest to

[86] See Hoffmeister, J., *Goethe und der Deutsche Idealismus. Einführung in Hegels Realphilosophie* (Leipzig: Meiner, 1932), pp. 35, 37, 9, 36.

[87] *Schriften*, ed. by Tieck and Schlegel, 4. Aufl (Berlin, 1826), II, p. 107.

[88] *Loc. cit.*, No. 393.

[89] *Loc. cit.*, No. 406.

[40] *Beitr. z. Elementarphysiologie* (Hamburg, 1797), p. 47 ff.

infinity, and volatile substances are the bases of life processes in animals and plants.[41] Accordingly, the psychical influences on the body are compared with the effects of poison, e. g. in Novalis' fragments.[42] "The soul is among the poisons the strongest. It is the most permeable and diffusible irritation; all psychical influences in local diseases and inflammations are therefore harmful." Similarly S. T. Coleridge [43] assumed latent life in all the organic world. This life is of low intensity, the inorganic world is asleep, dreaming, but not yet dead. Life means law of action, unity in multiplicity.

Romantic natural philosophy recognizes that matter and force are inseparable. If reason separates matter and force, the result is disintegration of the living organic being.[44] Force is a mere abstraction of reason without independent existence. On the other hand, the extreme materialistic view must be avoided which, e. g., supposes a fluid within the nerves, etc. (*Leupoldt.*)

Here we find relapses into archaic materialism which, in biology, had already been overcome by van Helmont. It was he who energetically rejected the theory of the origin of life in humid substances.[45]

Therefore romantic natural philosophy embraces two distinct doctrines: vitalism and materialism associated with pantheism.

The existence of *disease*, however, cannot be explained either by a *dynamic* or by a *materialistic* conception, for it is inherent in the solid, fluid and volatile parts, each of which can be the basis of pathological changes. But if life is derived from polarity, disease is a necessary consequence. In a state of perfect health life is impossible, because perfect health would be absolute unity, comparable with nothing, unlimited, and ideal activity alone.[46] Therefore one might die of excessive health, and life always requires a little illness. The same idea is similarly expressed by Novalis in his "Fragments":

[41] *Loc. cit.*, No. 417.

[42] *Loc. cit.*, p. 125.

[43] *The Theory of Life* (1848). See Needham, "S. T. Coleridge as a Philosophical Biologist," *The Scept. Biol., loc. cit.*, p. 160.

[44] Leupoldt, *loc. cit.*, p. 130.

[45] His treatise "Humidum radicale," *passim.* See my *Helmont, Leibniz, Stahl, loc. cit.*, p. 21.

[46] Ritter, No. 407, *loc. cit.*

"The ideal of perfect health is of interest from a scientific point of view only. Disease is inseparably connected with individualization. The same is true for the human mind as for the doryphorus or the canon in art. It is by diseases that men are distinguished from animals and plants. . . . Perishableness and fragility are characters of nature combined with mind. They witness the activity and universality, the sublime personality of mind." [47] According to Fludd's doctrine, also, disease and health are opposite poles necessary for each other. Fludd symbolizes the conception of polarity by the image of God's face being turned towards or away from mankind.

Certain remarks of Ritter [48] recall Marcus Marci's comparison of life with a flame and his differentiation of diseases according to the disturbance in the movements of the flame or in the intensity of its heat: "Should not all diseases be divided into such as originate (a) in a deficiency of oxygen in relation to the amount of matter to be oxydized, (b) in the deficiency of matter to be oxydized and an excess of oxygen, (c) in excess of both, (d) in a deficiency of both." [49]

Finally, there are parallelisms between the ontological conception of diseases assumed by Paracelsus [50] and van Helmont, and partially supported by Fludd, and the theories maintained by romantic authors. Some of these are well known, especially the parasitological theory of diseases enunciated by the school of Jahn, Stark, and Schoenlein. According to the teaching of these physicians, disease is an entity which penetrates the body like a parasite and can be detected in the pathological changes. Like the patient himself disease lives as an individual autonomic being. Since disease is a living agent, it is subjected to the universal laws of the macrocosm and the microcosm. It is in this sense that we must regard the subordination of disease to the universal laws when our romantic natural philosopher Ritter gives expression to the opinion: "Epidemic diseases appear to break out especially in spring. Being animals, they revive at this time like all other organisms. Infection

[47] *Loc. cit.*, p. 123.

[48] 450.

[49] See chapter IV on Marci; compare Novalis' "Fragments," p. 119, *loc. cit.*, "Sollte Denken oxydieren, Empfinden desoxydieren?"

[50] Compare Mich. Bened., *Lessing*, *loc. cit.*, p. 118.

should be considered as a process of reproduction and the disease itself as the young. Some of these unions may remain unproductive and it is necessary to investigate how the sterility in any particular disease is connected with the general fertility." [51]

Such a statement might have been made by Paracelsus, for it was he who imagined disease as being born in the body,[52] as the result of an invading entity or a spiritual force which, through all transitions, is connected with the contagium, a thing of finest corporality.

Thus the parallelism between romantic biology and medicine and the natural philosophy of Paracelsus and his followers is both apparent and impressive. In order to make this clear quotations have been given above from the works of K. W. Ritter. The same conceptions are found in the writings of the majority of the biological philosophers in the period of romanticism. As far as the doctrines of life force and the conception of force and matter in general are concerned, reference may be made to my discussion on the parallelism between romantic natural philosophy and the ideology of Rudolph Virchow.[53] In this I endeavoured to show that according to the expositions of Hartmann, Reil, Burdach, Treviranus, Troxler, the romantic doctrine did not in the least accept the naïve theories of a special life force equivalent to other chemical or physical forces; the old conception of life force, which may be called ontological, is superseded by a critical estimation of living beings, the peculiar structure and mixture of which is the cause of the peculiar functions of life. It was especially the vision of the world and man as unity, fundamental to natural philosophy, which forbade the separation and isolation of living beings.

This all seems to justify the denial of a peculiar character to the romantic movement in the early XIXth century, and to exhibit it as merely a repetition of the tendency, typical of mankind and reappearing in all periods, to explain nature by means of speculation and analogies — no matter whether this occurs in Greek antiquity, during the Renaissance, in the XIXth century, or at the present day. In so far as the early XIXth century has produced a valid biological doctrine, it is said not to be " romantic," and in so far as it is said to be romantic, that is, devoted to speculation and

[51] *Loc. cit.*, 452. [52] Mich. Bened., *Lessing*, *loc. cit.*, p. 118. [53] *Loc. cit.*

phantasy, it is said not to have produced a valid biology.[54] According to this criterion, therefore, the speculative aspect of the period is separated from the scientific, so that it is necessary to consider each author (such as Reil, Purkinje, etc.) in different lights, and to differentiate in his scientific production entirely different phases.[55]

But even the study of romantic thought in the XVIIth century justifies an estimate of the romantic natural philosophy of the XIXth century as a movement with its own problems and solutions of problems. The very fact that it is sufficient to choose one author in order to explain the typical mode of thought of the period demonstrates that we are dealing with a peculiar movement differentiated from its predecessors and successors. No matter whether we examine enthusiastic natures such as Novalis, Baader, Kieser, Troxler, J W. Ritter, or more sober investigators such as Reil, Hartmann, Steffen, Purkinje, always the same ideology, even the same terminology recurs. It is, therefore, impossible to exclude certain individual authors from the movement on the grounds of the comparative exactitude of their expositions, which can be accepted even today. The similarities existing between all these authors and their conceptions result from the fact that the same subjects and the same theories continually reappear in the writings of both categories of biologists, the sober investigators, and the fanciful enthusiasts.

Some of the fundamental conceptions, continually reiterated in the romantic natural philosophy, are identical with those of Fludd and other followers of Paracelsus. But there is more similarity in the mode of thought derived from the use of analogies between macrocosm and microcosm, conceptions like polarity, the combination of speculation with empirical research, the careful observation

[54] Diepgen, "Virchow und die Romantik," *Dtsche. medis. Wochschr.*, LVIII, 1932, pp. 1256-58. Compare my review on this paper in *Mitteilungen Gesch. Medis. u. Naturwiss.*, 1933, Vol. XXXII, p. 42.

[55] S. Bettmann in a delightful address to the Heidelberg Medizinisch naturwissenschaftlichem Verein (February, 1933), gave a splendid account of *Purkinje* with special reference to the relations of his scientific work to the romantic ideas of his youth and old age. There are the same relations which I have had already noted between romantic philosophy and the scientific work of Virchow (*loc. cit.*), especially in the stress he laid on physiology. I regret very much that Bettmann's lecture has not been published.

of psychical influences on corporeal processes, the ultimate identification of body and soul, than in the real subject-matter and the results of research. The two hundred years between 1600 and 1800 witnessed a great number of discoveries and new ideas which were reflected in romantic natural philosophy. The influence of Haller and Stahl on contemporary trends of thought is sufficiently evident. Physiology, which is the center of romantic biology, is a science in no way foreshadowed by Fludd and the other Paracelsists, with the possible exception of Helmont. It is only necessary to compare the writings of Burdach or the romantic conceptions of Purkinje with those of Fludd, in order to demonstrate the fundamental difference between them.

The estimation of nature as a unity was the same in the early XIXth as in the XVIIth century. But how different are the conclusions drawn from this monadic conception! In the romantic period, spirit and nature are but different stages in the development of the uniform substance of the world, a development from lower to higher degrees. In that speculative basis originates a particular interest in all organic processes, an interest which gives impulse to the study of embryology. As a matter of fact, modern embryology is based upon the naturalistic speculation of the early XIXth century. Important results of empirical research, e. g., Oken's discovery of the identity of the vitelline sac in birds with the umbilical vesicle in mammals, and the communication of the vitaline sac with the abdominal cavity are to be found in the midst of speculations which remind us very much of Fludd. According to some hypotheses every animal consists of two animals, the one governed by the brain and the other by the genital system. These opposite animals have one neutral point in common, the umbilical cord.[56] On the other hand, the so-called "fundamental biogenetic law," according to which the history of the germ repeats the history of the tribe, is foreshadowed by Kielmeyer,[57] Ennemoser,[58] Sal. Levy Steinheim,[59]

[56] See Nordenskjöld, E., *Geschichte der Biologie.* Deutsche Uebersetzung (Jena: Fischer, 1926).

[57] Buttersack, "Karl Friedrich Kielmeyer. Ein vergessenes Genie," *Arch. Gesch. Med.*, XXIII, 3, 1930, p. 236.

[58] Bremm, Jac., *Der Tiroler Joseph Ennemoser* (1787-1854). Ein Lehrer des tierischen Magnetismus und vergessener Vorkämpfer des Entwickelungsgedankens in der Medizin (Jena: Fischer, 1930).

[59] Pagel, Julius, Salomo Levy Steinheim, *Janus*, VIII, 1903, pp. 233, 286.

in their speculative estimation of the conception of development. It is the natural philosopher, K. E. von Baer,[60] who corrects such notions, teaching that there is a biogenetic law only in so far as there is a greater similarity among the embryos of organisms than among their adult forms.

Whereas embryology is based on the general speculative vision of processes of development in the whole history of the world, comparative anatomy originates in the deliberate observation of the analogies and parallelisms in the cosmos. This science is derived from the conception of fundamental types, which are in connection with the so-called "Urphaenomene," such as Goethe imagines in the magnet, in light, and in the grain of seed, etc.

In that sense, Cuvier's doctrine of types, which rejects all transitions between the types and all speculation concerning them, as well as Geoffrey St. Hilaire's comparative anatomy, which is based on the assumption of one fundamental type, is an offspring of the romantic period. Finally, there are the genuinely romantic ideas of the progressive development from lower to higher stages which lead Lamarck to the establishment of modern theories on the origin of species.

In the doctrine of diseases it is the speculative notion of life which provides the groundwork for the knowledge that during disease the same vital processes are present as in normal life, and that disease is life under changed conditions. This law is absolutely fundamental for the whole of romantic biology, the centre of which is "*physiology*." It reappears in the writings of almost every representative of this era, e. g., as Jul. Pagel demonstrated in 1903 — in the writings of Sal. Levy Steinheim,[61] of Reil, Burdach, Hartmann,[62] and the representatives of the natural-historical school.[63]

Romantic medicine, therefore, has obtained its peculiar character through its entanglement with the peculiar aims and the state of knowledge in the early XIXth century. One may object to the term "Romanticism" as the designation of these trends of thought, because romantic speculation is ubiquitous and, in every age, has

[60] See Nordenskjöld, *loc. cit.*

[61] *Loc. cit.*

[62] See my "Virchow," *loc. cit.*, p. 15.

[63] Diepgen, *Deutsche Medizin vor 100 Jahren. Ein Beitrag zur Geschichte der Romantik* (Freiburg und Leipzig, 1923).

produced its own peculiar ideas in medicine and biology as well as in other branches of science. The extent to which the method of analogies is employed is shown by the example of Fludd and his "Mysterium" of polarity.

The romanticism of the XIXth century has also a strongly developed connection with religion. It may be sufficient to refer to the names of Joh. Nepomuk Ringseis and Heinroth and their religious pathology which regards sin as the cause of disease.

But the natural philosophy of the early XIXth century marks a particular period because of its close connection with the scientific biology and medicine of the second half of the XIXth and XXth centuries of which it is the philosophical basis. In the foundation of modern embryology, comparative anatomy and morphology in general, as well as in the cultivation of the physiological aspects, it propounds and resolves its own problems.

VI

Mankind eagerly seeks after knowledge. Man devours knowledge like food whenever it is offered to him. But a very short time elapses before he vomits his indigestible fare. He seeks truth everywhere, but has never been able to give a sober and valid judgment on things.

Thus in the past the sceptic has always found himself in an isolated position; if he wished to proceed he had to begin from the very beginning, by doubting all statements about things and by investigating the things themselves, for this is the straight road to knowledge. But the more he pondered the more he must doubt; and this doubt finally led him to despair.

Nevertheless even then he adhered to his propositions. He applied to the scientists and obtained nothing but imaginary constructions, no knowledge of "Res naturales." By such fictitious tissues spirit can never be satisfied. Who can learn to understand that which does not exist, such as the atoms of Democritos, the ideas of Plato, the numbers of Pythagoras, the "Universalia" of Aristotle, his "Intellectus agens" and his "intelligentiae"?

Aristotle may have had his merits as an acute and ingenious observer within the narrow frontiers of human intellect. But did

he really grasp the universal and nature in the fullness of her powers? Did he indeed never make any mistakes? Did he actually know everything and demonstrate everything without doubt and contradiction? Did he really never evade difficulties and problems? It is sufficient to remember that he was a man like ourselves.

But should we epigons, conscious of human and, therefore, our own weakness, disparage the efforts of these heroes of knowledge?

There is one way out of the dilemma. It must be admitted that we are able only to fight for truth, never to attain it, and even if we could attain it we should never be able to hold it.

Nothing can be achieved by logic. Vain is the knowledge gained from syllogisms. Knowledge is not an accumulation of facts in the mind, but if it were obtainable, it would be an internal conception of unity, that is to say, philosophy. Such philosophy would be withdrawn from the relativity of sensual, especially optical, perception. Such philosophy would be able to apprehend not only the outlines of things but also their true essence. Hitherto nobody has been able to attain to this knowledge. Everything beyond the senses is confused, veiled in doubt and darkness. But even in the senses there is no power of recognition (" Sensus non cognoscit ").

How could such power exist? Everything is in a state of continual flux. Innumerable are the changes occurring between dawn and sunset. With reason it has been said that no hour leaves man unaltered. The identity of a thing does not permit the addition or subtraction of even a single particle.

There are only two ways which can lead poor mankind to the knowledge of things unrecognizable " per se," that is, experiment and critical examination. Each is dependent on the other, neither can exist without the other. But even these parts do not lead to real knowledge, because experiment is fallacious and difficult, and even when incontestable, shows only the exterior of the process and never the " naturae rerum." This also applies to human judgment, because we are able to judge only what has been demonstrated by experiment. As far as the nature of the thing itself is concerned, there remains nothing but conjecture which so often has been proved erroneous.

Nevertheless, experiment has its value, for it leads to the collection of experiences which can never be achieved by deduction alone.

Thus, according to experience and experiment antidotes are mixed and their effects proved again and again in the individual case. That which seems logically rational is very often proved to be contrary to truth. By mere deliberation nobody would conclude that hemlock mixed with wine causes death more rapidly and more easily in men with warm and bilious temperament, than in those with cold complexion.

Experience therefore makes a wise and prudent man.

By means of such arguments the physician Francesco Sanchez demonstrates a scepticism [1] which appears to be entirely emancipated from religion, an attitude which results in an abolition of religious and metaphysical feeling in the mode of thought of the "Renaissancemensch." [2] It takes the form of a pessimistic resignation which finally arrives at the recommendation of experience as comparatively the most reliable source of knowledge. This scepticism does not give birth to the strongly imperative impulse to natural research which was actuated by the religious view of Paracelsus and his followers, because the latter enjoyed the illusion that they could apprehend the real essence of things through their conception of the world and their mystical union with God. Such human achievement, however, is emphatically denied by Sanchez. It is no more than a figure of speech when Sanchez occasionally introduces the will of God as the first cause of the long life of plants and refers to God's omnipotence as identical with the order in nature, its necessity and fatalism. Such things are withdrawn from our knowledge. We can only investigate the second, that is to say, the natural causes which are the outcome of the effects of the former. Among such natural causes Sanchez, in his doctrine of the duration of life, pays special attention to the ancient dogmas of humoralism and qualities. His work is nothing but a philosophical essay, unconnected with any achievement in biology.

Similarly emancipated from religion and mysticism is the point of view of the priest Mersennus.[3] By virtue of the establishment

[1] "Tractatus philosophici quod nihil scitur; de divinatione per somnum ad Aristotelem," in *Libros Aristot. Physiognomicon comment., de longitudine et brevitate vitae* (Roterod, 1649).

[2] See Dilthey, *loc. cit.*, p. 36.

[3] Mersenne, Marin, *La vérité des sciences contre les septiques ou Pyrrhoniens*

of a new idea of rational science he refutes both the sceptic and the religious alchemist. In a discussion on the truth of science he introduces himself as the Christian philosopher in argument with the Pyrrhonian sceptic and the alchemist. The Christian philosopher deprecates the expression of doubt in all science as well as the connection of science and knowledge with faith and mysticism.

The *alchemist* defends his own knowledge as being the most secure, because obtained by experience, which he calls: " La mère, la source et la cause universelle de toutes les sciences." It is the lack of experience which causes the errors and failures of the Aristotelian system. Whenever Aristotle did not investigate the things themselves he substituted imagination for knowledge. Thus he made nothing but negative statements on nature. Moreover, his intellectual honesty is open to criticism.

On the other hand the *Christian philosopher* emphasizes the fact that the doctrines of Aristotle even today represent that system which most nearly approaches the truth. There is no doubt that Aristotle makes some mistakes, such as his faith in the finiteness of the world, the origin of the veins in the heart instead of in the liver, and so forth. But, in general his views are well founded, and, within the confines of human knowledge, are the best imaginable. The principles of Aristotle are " intellectuel et raisonable." This is the ideal of the priest and mathematician Mersennus.

The alchemist who desires to go further than the rough empiricism dealing with external appearances only, must also take the Aristotelian conceptions into account. Even the finest elixir of the alchemist is finally nothing but a combination of a " forma " with " materia," and the physician has to assume these principles when he wants to explain his operations and the efficacy of his remedies. The sum of the experimental knowledge of Aristotle may have been less than that of the alchemists of today, but as far as the principles of science are concerned the greater experience of the latter does not enable him to proceed any further than the former whose experiences were of a nature so simple as to be easily attainable by every man without danger to his eyes, his time or his means.[4]

(Paris, 1625). For Mersenne see: Tannery, P., *La correspondance on Mar. Mers., publ. et annot.*, Corn. de Waard., I, 1617-1627 (Paris, Beauchesne, 1932).

[4] " Des examples familiaires qu'un chacun peut voir et experimenter sans perdre les yieux, le temps et l'argent par la fumée des charbons et des fourneaux."

If, however, alchemy is really such a sober experimental science as the alchemist maintains, why then those strange analogies of macrocosm with microcosm, why that mysterious comparison of chemical processes with those which have occurred during the creation of the world and the resurrection of Christ? Why quote the Scriptures in order to explain the chemistry of mercury, the acids, and gold? Why refer to mythical beings, figures such as Demogorgo and Pan, Saturn who devoured his own children, Jason and Medea, and at the same time pretend to remain a true Catholic? Solemn declarations of faith in God and mystical utterances are employed in the writings of many alchemists only in order to hide their lack of knowledge. Capable alchemists scorn such poor fools who, while pretending to be enlightened by God, sell their ignorance as science and truth. God save us from such people who desire to change heaven and earth in order to fill their own pockets at the expense of those who cannot detect their errors!

Why does the alchemist keep his doctrines secret? Perhaps he desires to conceal the large amounts of silver he spoils or perhaps he wishes to have the advantage of the rest of mankind. It would be much better if, instead of enjoying the magical effects of light obtained by occult methods and by pure accident, he and his kind would build up their wisdom into a reliable science, founding chemical academies whose presidents should ensure that chemistry becomes a science methodically applied for the benefit of the human race. Charlatans must be punished and excluded from that noble work, and the barbaric and dark expressions must be abandoned.

Here the *sceptic* interrupts the discussion remarking that the extraordinary knowledge of nature which the alchemists assume cannot be obtained by natural means,[5] because the alchemists have frequently betrayed the greatest ignorance in the world. Their doctrine concerning the seed of all things, the peculiar virtue inherent in things, the life of the metals and their purification and transformation into elixirs by means of fire are mere dreams. As a matter of fact, the world consists of a small number of simple

[5] Compare this sceptic point of view of alchemy with that of the official jesuit doctrine of del Rio, etc., and Freitag (mentioned previously), according to which the effects obtained by the alchemists are not entirely denied, but the aid of demons and the devil is supposed. See my *J. B. van Helmont, loc. cit.*, p. 96 ff.

elements, the different combinations of which are the cause of all diversity.

The *alchemist* replies that the secret mysteries of the alchemists have nothing to do with an intercourse with the devil, against whom they use the weapons of the Catholic Church, such as prayer, the Eucharist, and the Holy Cross. The secrets of the alchemists, obtained hourly by experience, can explain nature better than all the wisdom derived from the syllogisms of Aristotle, which are fed by the experiences of natural research. The alchemist is ready at any time to forsake a doctrine if convinced by experience of the contrary. There is nothing in the aims of the alchemists which is opposed to the dogmas of the Catholic Church, when they try to discern the part played by the soul of the world in everything, representing it as a volatile salt. Therefore it is not the composition but the effect of things which matters.

True alchemists recognize the excellence of the doctrine of Aristotle, especially his theory of motion, the denial of which would be equivalent to the denial of daylight at noon. Aristotle *himself*, in his paper called "Magisterium," made use of the analogy between macrocosm and microcosm, calling alchemy a "lower astronomy." He compared chemical substances with the fixed stars, and Thomas Aquinas assures us that he has obtained the indestructible essential of the four elements.

The *Christian philosopher*, however, denies the authenticity of the documents mentioned. The author of the Aristotelian book is a Christian believing in the Biblical account of the creation of the world, about which Aristotle knew nothing. Furthermore, there is no tradition to the effect that the Doctor Angelicus "se soit amusé à ces opinions du fourneau." The alchemists are accustomed to ascribe new ideas to ancient sages such as Adam, Abraham, Moses, Esra, and Hermes.

These extreme points of view, that of the sceptic who denies the possibility of knowing anything, and that of the alchemist who feigns an acquaintance not only with the exterior of things but also with their true essence, are repudiated by the Christian philosopher. Sense perception has its own department. Each sense has its own object in reality. Human thought, which arranges and makes use of the sensual impressions, is not deceived, since it originates in the

divine light, the cause of the creation. This arouses in us meditation, exercise, experience, science. None of these can attain to anything without divine grace. Supernatural light increases the very narrow beam of our natural light to the knowledge of the divine being (" In lumine tuo videbimus lumen ").

Therefore reason is the measure of truth; truth itself the judge of our thought. Thought corrects its own errors, when truth reveals the fallacy of the orignal conceptions. In a problem the truth is nothing but " la conformité de ce qui est proposé avec l'entendement."

The importance of reason is evident particularly from the part played by mathematics in all sciences and all points of view. To the alchemists, who so often refer to the mysticism of numbers, it is mathematics which teaches the harmonic proportion which God has implanted in His works. We perceive in ourselves the harmony of the four humours, when they compose the " temper of justice." As health is the result of the preservation of the harmonic proportions of the elements of the body, so this principle is observed by the wise governor of such a state as the French monarchy. Therefore it is important to know the harmonic proportions of our humours. Some physicians maintain that these are 1:2:4:8, which means that one part of black bile corresponds to two parts of yellow bile to four parts of phlegm to eight parts of blood.

Thus the discussion of Mersennus with the alchemist and the sceptic leads to the confirmation of reason as the absolutely necessary basis of all science, in contradistinction to the opinion of the alchemist, and to the recognition of the possibility of man's attainment to the truth as opposed to the arguments of the sceptic.

Man's reason is part of the reason of God, and, like everything in nature, is created by God. Science cannot possibly be built up of rough empiricism alone — notwithstanding the great importance of the experimental results of alchemy which are capable of forming the foundations of a science. For Mersenne Reason is discursive thinking by means of the categories of Aristotelian logic — not " reason " (" Ratio ") in the sense of the general " Logos," which is innate in man as instinct, as is representative of the universal consensus in nature. This type of reason forms the basis, also of the

"religion of reason" in the stoic doctrine of *Herbert of Cherbury*, who is evidently influenced by Paracelsus and his "archeus."[6] Mersennus represents the viewpoint of the orthodox theology, which affirms reason and science, not that of Christian mysticism which denies both. It is characteristic that in medical biology he recommends mathematical deductions and returns to the ancient humoralism.

Like Mersennus, Francis Bacon separates religion from science.[7] He deprecates the construction of worlds and systems of philosophy from a small number of experiments in alchemy and physics. Free speculation and the construction of worlds, according to Bacon, is sin, and the outcome of a lack of reverence such as we find not only in ancient authors but also in Patritius, Telesius, Campanella, Paracelsus, and the alchemists. Instead of making careful investigation of the "seals" of the Creator, these philosophers have pondered on the "seals" of their own imagination. Instead of statements, hypotheses are made, experience is suppressed, man has triumphed over the works of God in his aspiration to be similar to God and to follow the commands of his own reason.[8] It is not the fire of the alchemists but the divine fire of human reason, which, in the realm of nature, has "to solve and to separate" skilfully in order to attain to positive results. Hence we must not rely upon miracles or natural magic which, like a soporific remedy, transports men into the realm of dreams and, by the fabrication of occult virtues and proprieties, detains them from the investigation of the true causes and all the good and real things which God has proposed for human research.[9] Similarly the discussion of the final causes has prevented the investigation of the physical causes. Therefore mankind has been satisfied with obscure and fictitious causes instead

[6] See Cherbury (1581-1648) and the stoic origin of his doctrines: Dilthey, "Weltanschauung und Analyse des Menschen seit Renaissance und Reformation," *Ges. Schriften*, II, 3 Aufl. (Leipzig, 1923), p. 248 ff., 260 ff.

[7] *Nov. Organ.*, I, 54.

[8] *Hist. natur. et experim. de ventis* (Amstelod: Elzevir, 1662). Prooem. — *De augment. scient.*, IX.

[9] *Hist. de ventis*, p. 118; — *Nov. Organ.*, I, 64; alluding to the construction of worlds from the Bible by Fludd is due to a "corruptio philosophiae ex superstitione" and "pro peste intellectus habenda" like the Pythagorean mysticism of numbers. *Ibid.*, I, 65.

of the real and natural causes.[10] Nevertheless, as already mentioned, Bacon did not entirely deny the achievements of alchemy, and admits a certain number of "instantiae magicae," which are proved by experiment.[11] He acknowledges the principal substances, sulphur and mercury, as symbols of the consensus of things.[12] To a certain extent the specific virtues are real, they may or may not be called "occult." Although the alchemists do not always attain to their aim they very often achieve other considerable results.[13]

On the other hand, Bacon refutes energetically the subjection of natural science to reason and logic which is obvious in the philosophy of Aristotle, who has committed the same crime as the alchemists and other empiricists by building up systems and worlds from his particular point of view.

Thus between mere empiricism and scepticism Bacon, like Mersennus, endeavours to found a scientific natural philosophy, but he seems to be disinclined to concede to reason and Aristotelian logic the high position it has obtained in the philosophy of Mersenne.

The recognition of the specificity of a substance, its peculiar innate virtue inaccessible to reason, was the fundamental principle of alchemy and was closely connected with the peculiar religious speculation which we have discussed. It was no less important a person than Robert Boyle who, standing on the borderline between alchemy and scientific chemistry, made this question the subject of a theoretical essay.[14] His conclusion that the specific virtue of a

[10] *De augment. scient.*, 3, 14.

[11] *Ibid.*, p. 49.

[12] *Nov. Organ.*, II, 50.

[13] *Ibid.*, I, 5; I, 73; I, 85. See Bacon's position with regard to Paracelsus and alchemy: Fowler, *loc. cit.*, p. 26 ff., and *passim*; further, the polemics of A. Ross against Bacon: "Arcana microcosmi or the hidden secrets of man's body discovered in an anatomical duel between Aristotle and Galen . . . with a refutation of Dr. Browne's vulgar errors, the Lord Bacon's natural history and Dr. Harvey's book *De generatione*" (Comenius, etc.: London, 1652), p. 251: "God will have us in some things rather *admire* his wisdom, than *know* his secrets . . . who can give the reason of that sympathy between the load stone and the iron? We see, there is a sympathy between some simples and some humours and between some parts of our body and some drugs." See the position of medicine in Bacon's system: H. Minkowski, *Archiv Geschichte Medizin*, XXVII, 299, 1934.

[14] *Of the reconcileableness of specific medicines to the corpuscular philosophy to which is annexed a discourse about the advantages of the use of simple medicines* (London, 1685). On Boyle's attitude to alchemy, see his *Chymista Scepticus*

substance is open to an atomistic explanation is one of the steps leading chemistry from the stage of prescientific empiricism to science.

Boyle insists that there is a specificity of substances which is not a matter of sorcery, but a quality which renders the substance in which it occurs more efficacious than an ordinary remedy in some particular case. This peculiar virtue is something which cannot be referred to the degree of any well-known property such as coldness, bitterness, and so forth; nevertheless its existence is evident from idiosyncracies, experience of the poison of spiders, the efficacy of emulsions of scorpions in the case of scorpion bites, etc., and similar instances quoted by Boyle from the works of Galen. The poisoned arrow of the Indians demonstrates that the quantity of a substance does not matter. Helmont's observation that water, after brief contact with mercury, is fatal to worms, even when there is no perceptible change in the weight of the water, is well founded.

Boyle is not disinclined to admit that there are things in nature inexplicable to our limited intelligence. But the atomistic theory of corpuscles is so simple and obvious that it is tempting to apply it in explanation of the specific efficacy of substances.

The body is a machine so finely adjusted that the efficacy of a substance is often due not so much to the substance itself as to the influence of one part of the body on another. This explains the diversity of the effects of specific substances and their validity in different diseases.

The effect of a specific substance consists (1) in a solution of the matter causing disease in such a manner that it can be excreted. The specific substance influences this matter on account of the suitability of its corporeal elements which must be so small that they can easily penetrate into the matter.

All conclusions derived by reason from an estimation of the known qualities of a substance are wrong, e. g., strong oil of vitriol is stronger in taste and dissolves more substances than aqua fortis. Therefore it might be concluded that like the latter, it dissolves silver. This, however, is not the case.

(Roterod., 1668). Ed. Faerber in Ostwald's *Klassiker der Naturwissenschaften*, vol. CCXXIX, 1930; Rob. Boyle in Bugge's *Buch der grossen Chemiker*, I (Berlin, 1929), p. 173; Needham, Joseph, *The sceptical biologist, loc. cit., passim.*

In any mixture the specific substance detects the substance to which its virtue is adapted. In a mixture of bone ash, Crocus Martis, sawdust, powdered sea salt and gold dust, water dissolves the sea salt only, while mercury will affect nothing but the gold.

The discovery of the circulation of the blood demonstrated that things which have once penetrated into the blood stream, are rapidly whirled into the most remote parts of the body.

These arguments apply also to the scepticism which denies the efficacy of amulets because they come into contact with the surface of the body only. All things emit very fine corpuscles which can penetrate into the skin through the pores; in this case they have greater effect than when they penetrate by the longer route of digestion. Instead of going through the door of the stomach the substances make their way through the keyholes of the skin directly into the blood stream.

(2) The specific substance can operate by neutralizing acidity which, according to Helmont, is the cause of many diseases. This result can be obtained either by substances endowed with positive hostility to acidity, such as alkaline salts, or, as a knife loses its sharpness, an acid corpuscle may lose its "prickling and cutting" power "by having its figure spoiled" by the action of an alkali. In this way chalk destroys the acidity of aqua fortis.

(3) The specific substance may precipitate the pathogenic matter, or

(4) it may strengthen the heart and hence the part of the body affected.

It is wrong to deride the doctrine of sympathy between an inanimate remedy and the living organ. The peculiar structure of the organs — and it is probable that the fluids are similarly constructed — and the varying sizes and quality of the corpuscles of some of the remedies point to the existence of an affinity between certain substances and certain parts of the organism. By fitting into the pores of an organ such substances can strengthen it, that is, increase its tonus, thereby enabling it to get rid of harmful matter.

In this manner even the most incredible effects can be explained rationally, e. g., the cure of scrofulous tumors by the touch of a dead

hand, a cure which has been ascribed to Helmont,[15] but which is really of earlier origin, or a handful of powdered skull bones as an antidote to nose bleeding, or the healing virtue of amulets, etc.

The scientist Boyle therefore explains the effects of magic operations and of specific substances in a scientific manner. He agrees with alchemists and mystics that there are effects due to antipathy and sympathy. Furthermore, he is ready to admit the impotence of human reason, but in the corpuscular theory he finds an alluring possibility of explaining occult things.

Like the mystic empiricist he, the scientist, deprecates[16] the application of the categories of Aristotelian scholasticism, such as "ideas," qualities, "substantial forms," to the doctrine of chemical substances. There are not any independently existing qualities. They are distinctions created by reason only in order to conceal self-contradictions. Definitions have no importance for the knowledge of matter and its qualities.

The quality of a thing depends upon its peculiar figure and size. Thus quality is not a specific entity separable from matter. The solubility of gold in aqua regis, but not in aqua fortis is due only to the special texture of the gold and not to any inherent peculiarity, nor does the gold of today differ from that of the time of Plinius because he was ignorant of this fact. Therefore "forma" and "species" are but the "peculiar manner of existence of a natural body, its specifical or denominated state, its essential modification, its stamp."

Thus there is no difference between natural substances and those produced artificially in vitro. God, who put matter in motion and established the laws of motion, is the first, though not the immediate cause of forms.

Boyle therefore agrees with the atomistic school in his theory that the world consists of innumerable individual corpuscles, and with Descartes in his belief that God is the origin of motion.

[15] Boyle appreciates Helmont in general as an ingenious and reliable investigator, except with regard to his treatise on the magnetic cure of wounds, which Helmont's friends maintain to have been published by his enemies. *Sceptical Chymist*, Everyman's Library, p. 51.

[16] The origin of forms and qualities (according to the corpuscular philosophy); illustrated by considerations and experiments. 2nd ed. (Oxford, 1667).

But Boyle expresses disagreement with the atomists when they deny God as the creator of the world, and from Descartes when the latter accepts God as the origin of motion in matter but not as the creator of the individual things.

Accordingly, Boyle affirms the existence of specific aims in nature as revealed by the number, form, quality, situation and type of motion of the celestial bodies, and the coöperation of the parts of the animals and plants for the benefit of the whole organism.[17] To Boyle, Descartes' God seems to be too much subjected to the iron laws of matter, according to which the quantity of motion is never changed. He cannot understand why God should not pursue certain aims and thus demonstrate a change in His way of acting in natural things. Why should His unalterability be violated if occasionally He alters the quantity of motion which He has put into the world. Man is inclined to draw anthropocentric and geocentric conclusions. In spite of that, there is no reason to deny that he may be one of the causes why the beams of the celestial bodies are sent to earth. The eye of the fly and the structure of the muscle are the most striking examples of teleology in nature. To imagine a knowledge of all the purposes of God is arrogance, but to know some of them is no "presumption, rather it is a duty to take notice of them." Not teleology, but accident, is a product of human reason, because everything that happens is subjected to the fixed laws of the activity and passivity of matter. It is on account of our ignorance that we cannot recognize the true coherence.

Physiology, without the investigation of causes, would be useless, but a careful study of the causes cannot prejudice the observation of purposes. In regard to the latter it is necessary to avoid haste in drawing conclusions and in making too many affirmations. Much cannot be recognized in its purposes at this time. Asclepiades would have declared the valves of the veins useless. Harvey, according to a personal communication to Boyle, was led to his discovery by the reflection "that so provident a cause as nature had not so plac'd many valves without design."[18]

[17] *A disquisition about the final causes of natural things wherein it is inquired whether and (if at all) with what cautions a Naturalist should admit them* (London, 1688).

[18] This reminds us of the opposite views in philosophy of Harvey and Fr. Bacon,

The recognition of purposes is the form in which the religious conception derived from Paracelsus is adopted and cultivated by science — as Boyle's example shows. Joseph Needham was right to emphasize the importance of the " causa finalis " in the biological ideas of the XVIIth century.[19] The " causa finalis " is the most prominent of the Aristotelian conceptions, when the conflict begins between the new " experimental " science and the philosophy of the schoolmen.

This is the sense of the passage from Sir Thomas Browne's " Religio medici " to which Needham is referring. " Every essence created or not hath its final cause, and some positive end both of its essence and operation. This is the cause I grope after in the works of Nature; on this hangs the providence of God." [20] Browne regards Galen's treatise " De usu partium " as the great achievement because it investigates the purposes of God. " Has Aristotle been as curious in the inquiry of this cause as he was of the other, he had not left behind him an imperfect piece of Philosophy, but an absolute tract of Divinity." [21]

Reason is unable to follow in the tracks of the wise hand which brings the seeds of the most imperfect creatures, such as bees and spiders, to development and function.

" Thus there are two books, from whence I collect my Divinity; besides that written one of God, another of his servant Nature, that universal and publick manuscript that lies expans'd unto the eyes of all." [22] Here we find a genuine idea of Paracelsus. The heathen forgot God and adored nature as the principle of motion and rest, instead of recognizing therein the straight line of God's order and laws. Thus each natural process is no more and no less a miracle than any other. Creation, e. g., when it " produces effects before nature " is as miraculous as when it " produces effects against or above nature." It is due to our limited intelligence only that certain

who refuted the final causes entirely in the realm of physics. See Fowler, *loc. cit.*, p. 132 f. Sir Humphery Rolleston, " Harvey's predecessors and contemporaries," *Ann. Med. Hist.*, X, 4, 331, 1928.

[19] *Chemical Embryology* (Cambridge, 1931), vol. I.

[20] *Relig. med.*, I, sect. 14, ed. Greenhill, p. 25.

[21] *Ibidem.*

[22] I, 16, p. 27.

effects in the work of God are regarded as contradictions or against nature[23]

Mersennus like Boyle represents a religious point of view. But this is fundamentally different from that of the mystic alchemists; on the other hand, the viewpoint of Boyle is quite different from that of Mersennus. The latter, the Christian philosopher, emphasizes reason as the cornerstone of science when he endeavours to rehabilitate Aristotle and to restore his system as the basis of modern science. To Mersennus religion is the clerical dogma, the "fides" which is followed and supported by reason and intelligence. Boyle, the chemist, however, refutes the sovereignty of reason in empirical investigation and therefore remains in connection with the mystic alchemists. He tries to subject the empirical knowledge of the latter to a modern scientific explanation provided by the atomistic theory of corpuscles. This scientific method is the point where he approaches Mersennus who also does not deny the empirical results of alchemy and endeavours to use them for the construction of a new chemical science. Furthermore, Boyle represents a pious independent faith in God, but, like Mersennus, he does not advocate mystic pantheistic speculation which is also absent from the thoughts of Sanchez.

By the development of the experimental empiricism of the alchemists into science, mystic faith is either altered into "Reflektierten Glaube" or it returns to the ecclesiastical dogma. In alchemistic mysticism religion was the starting point for investigation. It was the source to which the desire for knowledge of nature can be traced. Knowledge of nature and religion represented an inseparable unit. Therefore natural science was rather revelation to the individual than science which generally forces and constrains ("Zwingendes Wissen"). Now science is emancipated. Science has its own sources and purposes. Its results are objective; they may confirm religion, that is to say, the cognition of the supernatural, the existence of God.[24] But its activity is no longer the

[23] I, 27, p. 47.

[24] Compare the characteristic of Boyle's religion in its relation to science given by Joseph Needham: "Boyle was constantly striving to mediate between his science and his religion, which he by no means held in separate boxes, and his efforts often seem in a quaint and theological manner to anticipate Kant's union of opposites in the transcendent." *The Sceptical Biologist* (London, 1929), p. 225.

result of a religious feeling of universality. The microscope demonstrates the delicacy and complexity of living structures, thus affirming the ancient cabalistic and religious doctrine of preformation. Leibniz and Henry More [25] are such philosophers who stress these confirmations of religious truths by the results of experimental science. But their position demonstrates how far the process of separation of science from religion has now gone.

Just as in antiquity, once again the process of separation of faith and knowledge, originally a unity, has taken place. Once again one source of natural science has been the mystic-religious speculation on nature.

I am greatly indebted to Sir Humphrey Rolleston, Bart., Mrs. Dorothea Singer and Dr. Joseph Needham for having kindly revised the manuscript of this paper and for having offered several suggestions.

[25] On Henry More's relation to faith and science, see Powicke, F. F., *The Cambridge Platonists* (London and Toronto, 1926), p. 157 ff.

STEPHANVS DEFLACOVRT BISET INDIARVM ORIENT COLON GALL PRÆFECTVS. Natus Aurelius Devixit Peregrinus in Oceano Anno Salutis 1660 Die Decimo junii Aetatis Suæ 53.

TEXTS AND DOCUMENTS

AN EARLY TREATISE ON TROPICAL MEDICINE

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The account of the island of Madagascar given in 1658 by de Flacourt deserves a special place in the literature of travels of the seventeenth century. Born at Orleans in 1607 of a noble family, Etienne Bizet de Flacourt studied in the local college and university, travelled in Italy, Germany, England and Holland, and finally settled in Paris, where he became known for his interest in medicine and chemistry.[1] A nephew of Jules de Lognes, General Secretary of the Navy who, with several friends, founded the Compagnie Françoise de l'Orient, he accepted the post of Governor General of the colony which the Company had established as early as 1642 in the island of Madagascar. Flacourt resided in the island from 1648 to February 1655, made alliances with several native chiefs, and, with seventy-five or eighty men, succeeded in conciliating the inhabitants and obtaining recognition for the Company and the King of France. When he returned to Paris in 1655 he found himself involved in several law-suits, and was vehemently criticized by some of the partners of the Company. Partly to justify himself and partly to acquaint the public with the extraordinary resources and possibilities of the island, he published a relation in two volumes, consecutively numbered:

Histoire de la Grande Isle Madagascar. Composée par le sieur de Flacourt, Directeur general de la Compagnie Françoise de l'Orient, & Commandant pour sa Majesté dans ladite Isle, & Isles adjacentes. Paris, chez Alexandre Lesselin. M. DC. LVIII. Pp. xiv, vii, 192.

Relation de la Grande Isle Madagascar, Contenant ce qui s'est passé entre les François & les originaires de cette Isle, depuis l'an 1642 jusques en l'an 1655. Composée par le sieur de Flacourt . . . Paris, chez Alexandre Lesselin. M. DC. LVIII. Pp. xvi, 191.

[1] This biographical information is taken from the anonymous and very rare *Eloge de feu Monsieur de Flacourt*, 20 pages, printed shortly after the death of Flacourt, probably in Paris.

Each of these volumes deserves a detailed study. A born observer and a man of considerable learning for the time, Flacourt described not only the customs, government and life of the natives, but paid special attention to their religion, the medicine men and, most of all, to the animals and plants of the island. As most of them were new to him as well as to the European naturalists, he simply reproduced the names given to them by the natives, and thus listed more than a hundred and fifty herbs, plants and trees, some hundred birds, and about fifty species of fish.

Having won his case, and again possessing full confidence of the Company, Flacourt was appointed by the King Governor General of the new colony, and set sail for Madagascar from Dieppe, on *La Vierge,* a ship of two hundred tons, with two hundred soldiers, sailors and colonists, and six missionaries. The voyage was of short duration and had a tragic end. Overcome on the coast of Portugal by three vessels of the Barbary pirates, *La Vierge* was destroyed by an explosion in the powder magazine, and Flacourt and most of his companions were instantly killed. Only fifteen were rescued and taken prisoners to Algiers.

Picturesque as may have been his career as pioneer, great administrator and bold adventurer, neither his life nor even his relation would justify the attention of historians of medicine, had he not, during his stay in Paris, printed a pamphlet, hitherto neglected, of forty-two pages, entitled: *Cause pour laquelle les interessez de la Compagnie n'ont pas fait de grands profits à Madagascar.* Primarily intended for the members of the Company, unknown to bibliographers and found only in a few copies of Flacourt's relation, this short publication may be regarded as a most precious document for the history of colonization. The most curious part of it is certainly the special chapter in which the author studied particularly the diseases to which navigators and colonists were subject, and indicated in each case specific treatment and precautions to be taken to keep in good health in tropical climates. Speaking not as a theorician but as a man of experience who had to watch constantly over the health of a small group of Europeans, Flacourt was as much interested in the prevention as in the cure of disease. Without assuming to identify the "land and sea diseases" which afflicted the

adventurers, we may be permitted at least to point out that Flacourt was one of the first to prescribe a systematic regime for the prevention of scurvy. His name however is not even mentioned by early historiographers of the subject and he appears to have been equally neglected by more recent writers.[2] Long before the English and Dutch navigators he discovered the virtues of fruit juices and green vegetables. His recommendation to follow the example of the natives and to drink only hot water and well cooked meat in order to avoid intestinal troubles will also be noted. Short as it is this chapter seems to constitute the first treatise on tropical medicine and hygiene, and this alone would warrant its publication in this review.

Moyens dont il se faut precautionner contre les maladies du païs, & pour s'en garentir, tant sur terre que sur mer, soit en allant, soit en retournant.

Toutes les maladies qui sont contractées dans les voyages de long cours, qui se sont par mer & dans les païs chauds, sont, le flux de sang, le scorbuth, le mal de terre, & les maladies qui se contractent dans les païs chauds par les nouueaux venus. Le scorbut est vn mal tiré de la langue Hollandoise, qui est vne maladie qui s'engendre de la pourriture & corruption des humeurs dans les veines & dans le foye, à cause des mauuais alimens & de la corruption de l'eau que l'on boit dans le vaisseau, & des viandes sallées. Ce mal se connoist par vne lassitude de membres, contraction de nerfs, & particulierement des jarets (c'est pourquoy les Normans nomment ce mal, les Garets) par des marques noires aux cuisses & aux jambes, par vne puanteur d'haleine, & par des chairs excroissantes aux genciues vlcerées, & par vn degoust si grand, que si le malade n'est bien-tost mis à terre, il en meurt. Ce mal attaque l'ordinaire les plus robustes, lors qu'ils s'amusent à dormir par trop, & de iour.

Pour preuenir ce mal, il est necessaire de se diuertir sur le Tillac à causer, à se promener, à se presenter tous les jours à faire ses

[2] He is not to be found in the *Bibliotheca scorbutica, or a Chronological view of what has hitherto been published on the scurvy* which forms the third part of James Lind's *Treatise on scurvy*, London, 1752 and 1772. For more recent surveys of the question see also Alfred F. Hess, *Scurvy past and present*, Philadelphia and London, 1920, and M. A. van Andel, "Der Skorbut als niederländische Volkskrankheit" in *Archiv für Geschichte der Medezin*, 1927, vol. XIX, p. 82.

necessitez naturelles, & à ne demeurer point long-temps sans y aller, & à ne retenir son vrine, mesler vn peu de vinaigre dans l'eau pour y remedier quand on en est attaqué, il faut se frotter les genciues de jus de citron, & de vinaigre, ou de verjus, mais le jus de citron est meilleur, se frotter les jambes, cuisses, & parties malades, auec des huilles de Camomille, de vers, & autres emollientes & resolutiues, & mesme d'huille d'oliue, de sang de Marsouin, & d'huille ou graisse d'iceluy, & mesme du bouïllon dudit Marsoüin, quand on l'a tiré de la chaudiere, c'en est le meilleur remede, & à faute de ce, du bouillon où on a fait cuire le lard de l'equipage. Le jus de groiselles, de grenades aigres, & de berberis ou espine vinette, sont tres-bons à porter à la mer pour cette maladie. Le Theriacque, le Mithridat & l'Oruietan, les clysteres laxatifs y sont tres-bõs, les gargarismes auec de coctiõ d'horge, balaustes, roses rouges & vn peu d'alun & miel rosat, ou syrop de roses seiches, l'esprit de sel, l'esprit de souffre, & l'esprit de vitriol, sont de bons remedes pour s'en seruir vne goutte d'vn chacun ou de l'vn ou l'autre dans vn verre de breuuage, soit dans l'eau, soit dans le vin, soit dans quelques apozemes pour le malade. Les herbes & racines que l'on peut porter, sont les racines de chicorée sauuage, de persil, bruschus d'asperges, & les capillaires.

Il seroit necessaire de purger les malades dans le vaisseau auec vne poudre purgatiue, ou des pilules faites de ladite poudre. Cette poudre seroit composée auec resine de scammonée, jalap, turbith, & les hermodattes, de chacun vne once, & de clou de giroffle vn demy gros. Le tout meslé ensemble & en poudre subtile. La dose est pour les plus robustes, demy gros, dans vn boüillon ou dans vn verre de liqueur, cela purge doucement les humeurs flegmatiques & corrompuës; & ne donne aucune trenchées de ventre.

Le flux de sang quelque fois s'engendre sur mer, qui est causé d'vne grande inflammation des humeurs & d'vne resolution generale d'icelles, à cause de la salleure des viandes que l'on mange, & aussi de la grande diette que l'on fait, qui eschauffe le sang extrémement, à cela il faut remedier par des remedes humectans & astringens, tels que sont les sucs de grenades, de grosseilles rouges, de cerises & de berberis, de la teinture de rose rouges auec vn peu d'aigret de vitriol; & à s'abstenir quelque temps de manger des viandes sallées, des boüillons au beurre & aux herbes fines, qui sont le thim, la sariette,

l'hyssope, & quelques herbes que l'on a coustumé de porter à la mer, qui s'y peuuent conseruer. Les fruicts secs, comme sont les cerises seiches: les prunes de toutes façons, les raisins, les amandes & les noix seiches sont bonnes, comme aussi le bon cotignac d'Orleans, gros & clair, les coignasses, cerises, verjus & groiselles confites, l'escorce de citron, les figues & les dattes sont bons alimens pour ces sortes de maladies, la confection d'hyacinthes & encor mieux la confection d'Alchermes, l'eau de vie, & le vin d'Espagne & le bon rososol sont bons, mais en tres-petite quantité.

Le mal de mer se guerit sur la terre en prenant de bons boüillons d'herbes raffraischissantes, & principalement de l'ozeille, du pourpié, des laictuës & des chichorées & fautes d'icelles du potage au laict & à l'oignon & des autres legumes, & de l'vsage des boüillons de volailles & de la viande fraische. Mais le mal terre saisit le plus souuent ceux qui ayans esté sains à la Mer viennent à approcher de la terre, vn iour ou deux auparauant que de la voir, & mesme apres estre debarquez, qui est le plus souuent vne grande cholique, & vn grand vomissemens. Pour y remedier il faut promptement tirer du sang du bras, donner des clisteres laxatifs & raffraichissans, & vn peu carminatifs, donner de bons boüillons à la viande, & ne manger pas si tost des viandes solides; car cela prouient quelquefois d'vn degorgement de bille, & d'vne siccité des intestins. C'est pourquoy il est necessaire que les alimens soient humectans: ce mal passe le plus souuent en quatre ou cinq iours, puis apres ce temps il est necessaire de manger huict ou dix iours durant, au moins de bons potages à la viande, matin & soir, & les iours maigre, des potages aux herbes; affin d'humecter le corps qui estoit par trop desseché. Pendant ce temps l'on se purgera auec le sené, la casse, la rubarbe & la manne.

Les maladies qui se contractent dans les païs chauds par les nouueaux venus, sont la fiévre chaude & maligne, & l'enfleure qu degenere le plus souuent en hydropisie, & le flux de sang, la douleur & estourdissement de teste. Ceux qui meurent les premiers ce sont d'ordinaire de cette fiévre chaude, qui fait entrer les malades en de grands assoupissemens & lethargies, si ce sont des hommes replets; ou en frenaisies, ceux qui sont d'vn temperament secq.

Pour preuenir ces maladies, ou en emousser les plus grandes

violences, il faut apporter vn bon ordre en debarquant les passagers que l'on met à terre, les empescher de manger de la viande rostie, mais qu'elle soit boüillie, leur enjoindre de manger force potage à la viande. Leur deffendre de manger des citrons, si ce n'est vn peu dans leur potage, comme aussi le laict crud: car ce sont ces deux dernieres choses qui tuent la pluspart des nouueaux venus, qui d'abord voyans la facilité de manger des citrons, font tout ce qu'ils peuuent pour en manger à tous momens ainsi que du laict. Le citron, qui est acre & froid, leur imprime dans l'estomach son acidité, qui leur refroidit tellement, que tout ce qu'ils mangent en suitte se tourne & cõuertit en cruditez, lesquelles estãs enuoyées en haut dans le cerueau par le moyen d'vne chaleur excessiue du foye, qui est eschauffé, premierement par ce long ieusne souffert pendant cinq ou six mois en mer, puis par la chaleur du Climat, & par cette chaleur estrangere qui suruient, à cause de la corruption que causent ces cruditez. Les malades tombent dans vn grand assoupissement ou frenaisie, & meurent d'ordinaire dans quatre, cinq, ou six iours, & passent rarement le septiesme iour. Si ce sont des personnes melancholiques & d'vn temperament plus froid, ils deuiennent astmaticques & poussifs, & enfin tombent dans vne hydropisie qui les conduit au tombeau, si bien que ces deux maladies, quoy que bien differentes l'vne de l'autre, n'ont toutes deux qu'vne mesme cause & origine: & par ainsi pour les preuenir, il est necessaire de se seruir des mesmes precautions, ainsi que i'ay dit cy-dessus. Pour ceux qui sont attaquez de ces fiévres chaudes, il faut tout aussi-tost leur donner des Clysteres laxatifs, leur tirer du sang du bras iusques à deux ou trois fois: puis apres les seigner du pied pour attirer en bas les humeurs, & en empescher ce grand transport au cerueau; c'est vn remede tres-souuerain, & qui est infaillible, dont tous ceux qui ont eschappé, ont esté gueris.

Ceux qui sont en santé se doiuent faire saigner du bras dès aussi-tost qu'ils sont debarquez, se tenir le ventre lasche, & euiter les citrons, orenges, & le laict crud, & ne manger d'abord de la viande rostie. Ils se doiuent faire saigner tous les mois, & infailliblement ils se garentiront de ces grandes maladies. Qu'ils ne dorment point de iour, & moins encor au Soleil; qu'ils euittent les excez du boire & du manger, & que la nuict ils se tiennent couuerts l'estomach &

la teste principalement, qu'ils ne boiuent point d'eau trop froide, & qu'ils ne se baignent point dans les riuieres froides n'y ruisseaux qui descendent des montagnes. Et il leur est meilleur de boire plustost l'eau chaude que froide, ainsi que font le Negres & Insulaires, qui font chauffer leur breuuages, quelque soif qu'ils ayent, lesquels ont bien cette raison de dire que l'eau froide cause des obstructions à ceux qui en boiuent.

MEDICO-HISTORICAL ACTIVITIES IN THE UNITED STATES

BALTIMORE, MARYLAND

JOHNS HOPKINS UNIVERSITY

Institute of the History of Medicine

On February 1-2, Dr. Sigerist attended the annual meeting of the American Council of Learned Societies, which was held in Boston at the Academy of Arts and Sciences. On February 18-19, he attended the Annual Congress on Medical Education and Medical Licensure, where he read a paper on "The History of Medical Licensure," and gave an address before the Federation of State Medical Boards, on "Sidelights on the Practice of Mediaeval Surgeons."

The Institute has to acknowledge several gifts:

A most valuable 13th century manuscript of Constantinus Africanus, Viaticum Peregrinantium, with the commentary of Girard de Berry, presented by Mrs. Myrtle A. Crummer Ingram, in memory of Dr. Leroy Crummer.

Ten volumes of the Journal Général de Médecine, etc., 1803-1811, presented by Dr. Gregory Zilboorg.

A seal of the Maryland Medical and Surgical Institute, 1799, presented by Miss Gertrude Ballou.

The Hideyo Noguchi Lectureship

The fourth course under this foundation was given by Dr. Gregory Zilboorg, of New York. The general subject of the course was: The Medical Man and the Witch during the Renaissance. The three lectures held were as follows:

First Lecture: Thursday, February 7

The Physiological and Psychological Aspects of the *Malleus Maleficarum* (The Witch's Hammer).

Second Lecture: Thursday, February 14

Medicine and the Witch in the Course of the Sixteenth Century.

Third Lecture: Thursday, February 21

Johann Weyer, the Founder of Modern Psychiatry.

During the month of February, the remarkable collection of books on witchcraft of Dr. Christian Deetjen was on exhibit in the Exhibition Hall of the Institute.

Dr. Zilboorg's lectures will be published as Volume II of the Third Series of the Publications of the Institute of the History of Medicine, to be issued early in the Spring.